

THE HANDMAID TO THE ARTS. IN TWO VOLUMES,

TEACHING,

- I. The Preparation of Inks, Cements, and Sealing-Wax, of every kind.
- II. The Art of Engraving, Etching, and Scraping Mezzotintos; with the Preparation of the Aqua Fortis, Varnishes, or other Grounds, &c. in the best manner now practised by the French; as also the best Manner of Printing Copper-plates; an improved method of producing Washed Prints, and of Printing in Chiaro Obscuro, and with Colours, in the way practised by Mr. Le Blon.
- III. The Nature, Composition, and Preparation of Glais of every sort; as also the various Methods of Counterfeiting Gems of all kinds, by coloured Glass, Pastes, Doublets, or the use of Foils.
- IV. The Nature and Composition of Porcelain, as well according to the Methods practised in China, as in the several European Manufactories; with the best Manner of Burning, Glazing, Painting, and Gilding the Ware.
- V. Preparation of transparent and coloured Glazings, for Stone or Earthen-ware.
- VI. The Manner of preparing and Moulding Papier Mache, and whole Paper, for the forming Boxes, Frames, Festoons, &c. and of Varnishing, Painting, and Gilding the pieces of each kind; with the Method of making the light Japan-ware.

TO WHICH IS ADDED

AN APPENDIX,

CONTAINING

Several Supplementary Articles, belonging, in some manner, to Heads before treated of, either in this or the First Volume; particularly, the Method of Marbling Paper, of taking off Paintings from Old and transferring them to New Cloths; of Weaving Tapestry, both by the High and Low Warp; and of Manufacturing Paper Hangings of every kind.

A NEW EDITION,

WITH CONSIDERABLE ADDITIONS AND IMPROVEMENTS.

VOL. II.

LONDON:

PRINTED FOR A. MILLAR, W. LAW, AND R. CATER;
AND FOR WILSON, SPENCE, AND MAWMAN, YORK.

Anno 1796.

James. Cobbett &

July 13th 1837



1608/300.

PRINTED BY

WILLIAM COBBETT, LONDON, AND NEWCASTLE

VOL. II

LONDON

PRINTED FOR A. MILLAR, 14, LANE, AND S. COOPER,
AND THE WILSON, STENCE, AND MANMAN, 10, LANE.

1837

THE
P R E F A C E.

THIS volume of the *Handmaid to the Arts* contains such additional articles, as, either for want of room, could not be inserted in the first, or, not being strictly a part of the design, were omitted there; though, from their affinity with it, and their common utility, they may justly claim to be joined to it in a supplementary light.

The general title of the work points out the object of its contents; viz. *an attempt to teach the knowledge of all such matters as are subservient to the arts of design, but yet not absolutely a part of those arts themselves*; and the preface to the first volume shews more explicitly the nature of the undertaking, and the motives of the author for entering upon it. It is therefore needless to enlarge further on these points here in a general view, as nothing more is wanting than to give some account of the manner in which the several particulars, which form this volume, are here treated of.

The preparation of *inks, sealing-wax, and cements* of every kind, makes the first part. The reasons for their being made a part of this work were, as well as their great general usefulness, for many other purposes of life, as their being necessary in the practice of several of the principal arts of design, though not immediately belonging to any in particular. Black writing ink, more especially, is of the utmost importance, and the composition of it of a very nice and precarious nature, as the many instances of writings wholly obliterated, or become so faint as to be scarcely legible, too frequently evince. Yet those who would avoid the hazard of being supplied with bad ink from others, by preparing

themselves what they use, would find it difficult to procure, from any book, a recipe for this purpose, on which they could safely depend, *Caneparius*, an Italian, has indeed written a whole volume in Latin on inks, and there are some recipes in it which are not very faulty. But he has not given any just light into the true nature and use of the several ingredients, nor, by any other means, removed the great difficulty of judging of the due relative proportion of them, on which nevertheless the success of the process chiefly depends. On the contrary, he has accumulated a multiplicity of forms, in which the widest difference in this point, that can be imagined, is found; and from the neglect of intimating in what particulars any of them are erroneous, and in what proper, though it is apparent, from the nature and degree of the difference, that if some be right, others must be wrong, he has rendered the whole of little consequence. The succeeding writers have copied from his work, without remedying this defect, and have either given, like him, a variety of recipes, some very bad, and others less faulty, without distinguishing them, or for the most part chosen the worst, in which not only the same errors in the proportions are found, but wine, vinegar, and other such unnecessary and injurious substances, are introduced, to enhance the expence, and deprave the produce. With respect to the printing ink, there is little to be communicated as to the common kind; because the goodness of that arises more from the choice of the ingredients, than from any skill in the management of them, and I have therefore treated it with proportionable levity. But with relation to the sort used for printing copperplates, it is much otherwise; and, as the effect of the engraving greatly depends on the ink, the recipes here given must be allowed to be an improvement, with respect to ourselves, of the art of printing, as they teach the manner of preparing the best kind now used in France, which is greatly superior to any commonly made here; and another sort also, which though not brought into practice hitherto, would excel any other at present known.

Engraving, with a view to the production of prints, is the subject of the next part, and was very essential

PREFACE.

to the design of this work; and it is hoped, that what is here offered on this head will not be less useful to the public than acceptable to those who cultivate the art, as it may not only enable many, who might attempt engraving, if they were not debarred from proceeding by the want of such aid, to initiate themselves into the rudiments, but even assist those who are already advanced to some degree of ability in the practice of it. It was intimated in the preface to the first volume, that means had occurred of obtaining a considerable stock of very valuable matter respecting this subject. What was meant by that intimation was, the publication of Le Bosse's treatise on the manner of etching and engraving, with the additions of Mr. Cochin. He has subjoined to the contents of that treatise, all the newer methods of the present practice; together with many edifying observations, deduced from the principles of design, and illustrated by examples of the most eminent masters. So that his work is not only valuable, as conveying the greatest part of the general rules of the art, but as imparting also the peculiar inventions and improvements of the French, which could be hitherto known only to those who had the opportunity of studying it in France. I think it proper to acknowledge, therefore, that a great part of the matter given on this head is borrowed from them; but it is presumed this will rather be considered as a recommendation than a disparagement of the work, by those of our own country, where this art is of a much younger growth. The instructions which were required to be furnished with relation to engraving, in a general view, could only be laid down originally by such as were thoroughly versed as well in the practice as principles of it; and the peculiar methods of the French, only by such as had been educated, or had resided long there. None could be more capable or communicative of either than Le Bosse (who was one of the first introducers of etching into France) has been with regard to the hard varnish; and the ingenious Mr. Cochin, who is at present an eminent engraver at Paris, with respect to etching with the soft varnish; the engraving with the tool or graver; the advantageous combination of etching, and the work

of the graver, in the execution of the same design; or the general history and principles of the art. It must not be understood, nevertheless, that only a translation is given of what Le Bosse and Cochin have written on this subject. A regular treatise on engraving is here attempted, in which every thing necessary to be known, as far as relates to the execution of any design, is methodically taught; while those two authors, on the contrary, who were much more able artists than writers, only touched on particular heads, and sometimes with such a deviation from the just order of didactic method, as to render their instructions perplexed and difficult to be conceived. Several observations on, and improvements of, what Mr. Cochin has taught, as well as other particulars, are also added; so that it is presumed what is here afforded may be much more useful than any translation of his or Le Bosse's works, and may contribute to advance that progress we are making towards a rivalship of the French in this art, which they have for a considerable time cultivated and encouraged in the greatest degree. To the instructions for engraving are added the method of printing copperplates, and an improved manner of producing washed prints, proposed by Mr. Cochin in the above mentioned work; with observations tending to the rendering it yet more useful. The manner of printing in *chiaro oscuro*, and with colours, after the manner of Mr. Le Blon, are also subjoined; and will be doubtless very agreeable articles to those who are curious in matters of this nature.

The third part contains a dissertation on the nature, composition, and preparation of every sort of *glass*, as well coloured as transparent, and consequently of the kinds manufactured for the imitation of precious stones, as well as the more coarse sorts made for common purposes. To this is annexed an account of the formation and management of *doublers*; of the means which have been employed for colouring crystals; and also of the preparation and application of *foils* of all kinds. The manufacture of glass is an object of the greatest importance to commerce. It is more particularly so at present, as the French have gained the accidental advantages over us, in one of the most material articles,

to such a degree, that a very considerable sum is annually paid on account of the clandestine importation of the produce of their manufacture to us. And this notwithstanding, were matters put on a fair and equal footing, we could underwork them ten or fifteen *per cent.* from the natural advantages we have over them in more than one circumstance. The assistance, however, given by books already published, to those who would cultivate the art of making glass, is extremely slender; though there are many writers who have pretended to teach it, and three in particular who bear a considerable reputation. The first of these is Neri, an Italian priest, who wrote an original treatise on glass, and on the preparation of pastes, or compositions for the imitation of precious stones, with some other curious arts. His book contained an account of the composition and treatment of some of the kinds of white transparent glass, then made in Italy; as likewise of the methods at that time practised with respect to colouring glass, and the preparing enamels. But he was far from having collected a full account of the Italian manufactures of glass; and where he attempted to treat the subject in a scientific manner, he betrayed great error in reasoning, and ignorance of principles; and indeed the whole of what he delivered was very imperfect with respect to method, even to the accumulating repetitions on each other. He is nevertheless still more blameable for having introduced many falsities respecting the result of processes and experiments that, he says, he had performed; and which he relates to be greatly different from what they really ever were in fact. Dr. Merret, an English physician, translated Neri, and wrote notes upon him. But not having any experimental acquaintance with the subject, nor any knowledge of the principles, except what he had borrowed from a very few bad writers, he adopted all the errors of Neri; and making them and other false suppositions, with respect to facts, the data on which he formed his hypothetical reasonings, he treated his subject as absurdly as any of those have ever done others, who, like him, pretend to obtain a knowledge of this kind in their closets. It was far otherwise with Kunckel, who retranslated into

his own language Neri's work, with Merret's notes; and superadded many remarks and observations of his own on what both of them had advanced. He had been superintendant of the manufactures of glass and chemist to several of the Electors, and other German princes, who were at that time great cultivators of those kind of arts, and had a very minute acquaintance with the subject, gained as well by a great number of speculative experiments, as a constant attendance on the established practice; to which he joined a considerable share of natural sagacity. His advantages, therefore, besides that of living at a time which, though not long after Merret, had given room for many considerable improvements to be made, were much greater than those of Merret and Neri, for writing on this subject; and indeed his works may be justly deemed proportionably superior. For though he was illiterate in other points, and had not all the aid from natural philosophy, and the deeper principles of chemistry, he might have even then received, and moreover published his observations on this art, only under the form of notes on those two preceding writers; yet his work has a real value; and, as far as he has extended it, may vie with most others written on practical subjects of so curious and complex a nature. His observations with respect to white transparent glass are confined to the best kinds of glass of salts; for he neglected to give any instructions relating to those employed for coarser purposes; and the sort we now call flint-glass is of later introduction into practice. The English writers of dictionaries, and other books of arts and trades, have done nothing more than to translate or transcribe from Neri and Merret, and not understanding the changes of the practice since that time, nor what substances are employed here correspondently to those then used in Italy, they have given only what must appear to the practitioners of this art an unintelligible jargon; their receipts directing constantly the use of pulverine, rochetta, tarso, sado, grappola, &c. things which were never known here, and are scarcely at present found or even understood in Italy. With respect to the general nature of glass, in a speculative view, it has indeed been well conceived,

and occasionally treated of, by several both of the German and French writers, as Henckel, Raumur, Cramer, &c. But with respect to the practical knowledge or art of making the several kinds now in use, it may be justly deemed to be hitherto untaught; as whoever should try to inform themselves of the particular qualities and composition of flint-glass, window-glass, that employed for plates for mirrors, or any other particular kind, would find the means wholly unprovided in any books. I have therefore concisely laid down the general principles on which the nature of glass is to be explained; and then enumerated the qualities and uses of the several ingredients in the kinds now made; after which I have proceeded to give the composition, and rules for the treatment of each particular sort, so that every thing may be furnished, either for the learning the present practice, or making experiments for the further extension and improvement of the art. The preparing coloured glass for the imitation of precious stones had indeed been more extensively taught by Neri and Kunckel, and the writers after them. But in all their works, along with some good recipes, there were others intermixed that were very liable to mislead such as might make use of them, and occasion a fruitless expence of time and money. A complete set of processes for the best composition and treatment of every sort was consequently still wanting, and is here attempted to be supplied in the most effectual manner. The preparation and management of soils is a proper appendage to the coloured glass, being subservient to the same purpose, and was therefore annexed to this part of the work.

In the fourth part, the nature and manufacture of *porcelain*, or *China-ware*, is taught, which will be doubtless acceptable at this time, when attempts are making to establish five or six different manufactories in our own country; which, considering the great advantage received from those of Dresden and Vincennes, ought certainly to meet with all the encouragement and assistance that can be given either by the public or by private persons. To this is added Mr. Raumur's method of *converting glass into porcelain*, an article which, if it may

not be sometimes rendered useful, is at least very curious.

The fifth part contains a complete set of recipes for *transparent and coloured glazings* for stone and earthen-ware. This article was indeed supplied before in some degree, in the first volume, by the enamel colours. But as Kunckel had made a collection of all the methods of preparing the glazings at Delft, and published it in his work; and as there are some kinds that differ from any of the compositions used for enamelling, I thought the giving the detail of the whole might be serviceable. This is indeed of greater importance at present, as there is now a great spirit of improvement in the manufacture of stone and earthen-ware, which ought to be encouraged and aided by every means, as the French have of late greatly supplanted us in this branch of commerce, even so as to supply Ireland to the amount of twelve or fourteen thousand pounds worth *per annum*.

The sixth part consists of an account of the best methods of preparing the *papier mache*, either applied to embossed work and bas-relieves, or to the forming boxes, &c. and to this is subjoined the method of making the same kind of small pieces, or tea-cups, saucers, &c. from whole paper, and also from saw-dust. The manufacture of the *papier mache* being new in this country, it is more particularly useful to propagate the art of preparing, forming, and ornamenting it for the various purposes to which it is applied, that a greater number may be induced to engage in cultivating a branch of commerce in which we have already rivalled our competitors at foreign markets.

To these six regular parts of the work are added an *Appendix*, containing such articles as were before omitted, though belonging, in some manner, to the former heads. The principal are, the art of weaving tapestry as well by the high as low warp; the whole manufacture of paper hangings, and some other detached articles.

The above six parts and appendix, together with the first volume, contain the whole of what appears to be

necessary for the completion of the design of teaching all those lesser and subordinate arts, that are requisite to the execution of the several arts of design; and I flatter myself, therefore, the work will be found to comprehend all the material articles that fall properly within the pretensions of the title.

I hope also, they will be found to be so treated of, as may render them most extensively useful, as well to professed artists as others; especially, as in this edition every thing has been added, which the most industrious research could procure, since the publication of the first; and the former contents corrected and explained, with the greatest care and attention, wherever there appeared the least occasion for it.

CONTENTS.

PART. I.

Of Inks, Cements, and Sealing-Wax.

CHAP. I.

Of Inks.

SECT. I.	Of Inks in general	-	-	-Page
SECT. II.	Of Black Writing Ink	-	-	13
SECT. III.	Preparation of Red Writing Ink	-	-	14
SECT. IV.	Preparation of Green Writing Ink	-	-	20
SECT. V.	Preparation of Yellow Writing Ink	-	-	21
SECT. VI.	Of Printing Inks	-	-	22
SECT. VII.	Of Secret Inks	-	-	24

CHAP. II.

Of Cements.

27

CHAP. III.

Of Sealing-Wax.

SECT. I.	Of Sealing-wax in general	-	-	35
SECT. II.	Composition of hard Sealing-wax of various Colours	-	-	36
SECT. III.	Composition of soft Sealing-wax	-	-	38
SECT. IV.	Of the manner of forming Sealing-wax into Sticks, Balls, Rolls, or Cakes; and of perfuming it	-	-	38

PART II.

Of Engraving, Etching, and scraping Mezzotintos.

CHAP. I.

Of Engraving in general	-	-	Page 42
-------------------------	---	---	------------

CHAP. II.

Of the choice and preparation of Copperplates for Engraving	-	-	45
---	---	---	----

CHAP. III.

Of Engraving with the Tool or Graver.

Page			
13			
14			
20	SECT. I.	General Nature of Engraving with the Graver	49
21	SECT. II.	Of the Apparatus, or set of Instruments necessary for Engraving with the Tool	50
22	SECT. III.	Of holding and handling the Graver	53
24	SECT. IV.	Of the general manner of managing the Graver	53
	SECT. V.	Of the particular manners of Engraving	55
	SECT. VI.	Of Engraving in Great	60
27	SECT. VII.	General Maxims of Engraving with the Graver	62

CHAP. IV.

Of Etching or Engraving with *Aqua Fortis*.

35	SECT. I.	General Nature of Etching	63
36	SECT. II.	Of the Instruments employed in Etching	64
38	SECT. III.	Of the composition and preparation of the soft Varnish	68
38	SECT. IV.	Of the composition and preparation of the hard Varnish	72

	Page
SECT. V. Method of applying the soft Varnish to the Plate, and of blackening it	73
SECT. VI. Method of applying the hard Varnish on the Plate, and of blackening and drying it	75
SECT. VII. Method of making the Varnish White, where that colour may be preferred to Black	79
SECT. VIII. Method of Calking and Retracing the Design on the Varnish of either kind	80
SECT. IX. Method of counter-proving the Design upon the Varnished Plate, in order that the Print may be turned the same way with the Picture or original Drawing	83
SECT. X. Of the general Manner of Engraving on both kinds of Varnish	86
SECT. XI. Principles respecting the manner of Engraving, with the methods applicable to particular subjects	94
SECT. XII. Of the manner of Engraving particular subjects	103
SECT. XIII. Of the preparation and composition of Aqua Fortis, proper for each kind of Engraving	108
SECT. XIV. Of the mixture of Tallow and Oil for covering the Plates, to secure them from further corrosion, when necessary	111
SECT. XV. Of the method of putting the Plate in a proper state to receive the Aqua Fortis, and of pouring it on the Plate; with the manner of applying the compositions for preventing the Sweetenings, Lights, &c. from being corroded beyond the due degree	112
SECT. XVI. Of the manner of taking the Varnish off the Plate, when the corrosion by the Aqua Fortis is finished	121
SECT. XVII. Of the manner of Re-engraving, by means of Aqua Fortis, what may have been at first forgotten, or may be desired to be added after the Plate has undergone the operation of the Aqua Fortis	123

CHAP. V.

Of scraping Mezzotintos, and the applying that art to the production of Coloured Prints resembling Pictures.

SECT. I. Of the general Nature of scraping Mezzotintos	125
--	-----

CONTENTS.

XV

Page		Page
73	SECT. II. Of the Instruments used in scraping Mezzotintos, and preparing the Ground	127
75	SECT. III. Of the manner of forming the Ground on the Plate, in order to the scraping in Mezzotinto	128
79	SECT. IV. Of the manner of scraping in Mezzotinto	130
80	SECT. V. Of the application of the Art of scraping Mezzotintos, to the Printing with a variety of Colours, in order to produce the resemblance of Paintings	131

CHAP. VI.

Of the method of Printing Copperplates.

94	SECT. I. Of the Instruments necessary for Printing Copperplates	136
103	SECT. II. Of the Printing Ink	139
108	SECT. III. Of the manner of Printing Copperplates	139
	SECT. IV. Of the method of producing Washed Prints much more beautiful than the common	150
	SECT. V. Of the method of Printing in Chiaro Obscuro	152

CHAP. VII.

Of Engraving Wood with a view to Printing 154

PART III.

Of the nature and composition of Glafs, and the art of counterfeiting Gems of every kind.

CHAP. I.

Of Glafs in general - - 158

CHAP. II.

Of the particular nature of the materials used in the composition of manufactured Glafs.

SECT. I. Of the materials serving for the body of Glafs 164

SECT. II. Of materials used as Fluxes in the composition of Glafs	Page 173
---	-------------

CHAP. III.

Of the instruments and utenfils employed in the composition and preparation of Glafs	176
--	-----

CHAP. IV.

Of the preparation and composition of the several kinds of white transparent Glafs now in use.	
--	--

SECT. I. Of the several kinds of White Glafs and their composition in general	180
SECT. II. Of the nature and composition of Flint-glafs, and the German Cryftal-glafs	182
SECT. III. Of the nature and composition of the Glafs proper for Plates, for Mirrors, or Looking-glaffes	187
SECT. IV. Of the nature and composition of Window-glafs	190
SECT. V. Of the nature and composition of Glafs for Phials	191

CHAP. V.

Of the commixture of the ingredients for composing Glafs, and the manner of the fusion and coction of the several compositions of the white transparent kinds, in order to their being duly incorporated and vitrified	193
--	-----

SECT. I. Of the commixture of the Ingredients for the several compositions of White transparent Glafs	193
SECT. II. Of the manner of melting and fusing the several compositions, in order to their conversion into Glafs, with the means of judging when the vitrification is perfect	195
SECT. III. Of the means of promoting and accelerating the perfect vitrification of the Ingredients, when the composition proves defective in that point, with the means of removing any Yellowish or Greenish tinge that may arise	197

CHAP. VI.

	Page
Of the composition and treatment of the common Bottle or green Glass	199

CHAP. VII.

SECT. I. Of the general nature of coloured Glass, and of the several compositions proper for receiving the Colours, in order to the forming Glass or Pastes, in imitation of precious Stones, with the qualities attendant on each	201
SECT. II. Of the nature and preparation of the substances used for tinging Glass	203
SECT. III. Composition of hard Glass and Pastes proper for receiving Colours	205
SECT. IV. Composition of Glass, or Pastes, of a Red Colour	209
SECT. V. Composition of Glass and Paste of a Blue Colour	211
SECT. VI. Composition of hard Glass and Pastes of a Yellow Colour	213
SECT. VII. Composition of hard Glass and Paste of a Green Colour	215
SECT. VIII. Compositions of Glass and Pastes of a Purple Colour	215
SECT. IX. Of Paste resembling the Diamond	216
SECT. X. Composition of hard Glass and Paste perfectly Black	217
SECT. XI. Of the white, opaque, and semi-transparent Glass and Pastes	217
SECT. XII. Composition of coloured, opaque, and semi-transparent Glass	219

CHAP. VIII.

Of the fusion and vitrification of the several compositions of coloured Glass, with the particular rules and cautions to be observed in the management of each kind	222
---	-----

CHAP. IX.

Of colouring Rock-crystals for the imitation of Gems	225
--	-----

CHAP. X.

Of Doublets

Page
229

CHAP. XI.

Of Foils.

SECT. I. Of the general nature and preparation of
Foils

232

SECT. II. Of the colouring of Foils

234

SECT. III. Of Foils for Crystals, Pebbles, or Paste, to
give the lustre and play of Diamonds

237

PART IV.

Of the nature, composition, glazing, painting, and gilding of Porcelain, or China-ware, and the conversion of Glass into Porcelain.

CHAP. I.

Of the general nature and management of Porcelain
and China-ware

239

CHAP. II.

Of the composition for China-ware

242

SECT. I. Of the manner of formation of Vessels, Figures, Flowers, or other pieces of China-ware

247

SECT. II. Of the first baking or hardening the China-ware

248

SECT. III. Of the composition for, and manner of glazing China-ware

250

SECT. IV. Of the second baking or burning of the China-ware

253

SECT. V. Of the painting and gilding the China-ware

256

SECT. VI. Of the conversion of Glass into Porcelain, according to the method invented by Mr. Raumur

258

P A R T V.

Of the preparation of transparent and coloured glazings for Stone and Earthenware - - 259

P A R T VI.

The method of preparing and moulding Papier Mache and whole Paper, for the forming boxes, frames, festoons, &c. with the manner of making the light Japanware - - 274

CHAP. I.

Of the preparing and moulding the Papier Mache - - 274

CHAP. II.

Of the manner of moulding, &c. the whole Paper for the forming Snuff-boxes, Cups, &c. 278

CHAP. III.

Of the manner of preparing the matter and moulding the light Japanware - 279

CHAP. IV.

Of the painting, gilding, and varnishing the Snuff-boxes, Cups, &c. formed of the Papier Mache, the whole Paper, or Saw-dust - 280

APPENDIX,

Containing several supplementary articles,
belonging in some manner to heads before
treated of, either 'in the first or second
volumes

Of the method of preparing and colouring marbled Paper	283
Method of taking off paintings in Oil, from the cloths or wood on which they were original- ly done, and transferring them entire, and without damage, to new pieces	286
The original recipe for the making Prussian blue, as published by Dr. Woodward	290
Of light red, or light Ochre, (which should have been inserted p. 68 of the first volume of this work.)	293
The method of foliating, or silvering Looking- glasses	293
Varnish proper for Pales and coarse Wood- work	297
Preparation of Ivory for a ground for miniature painting, omitted in the first volume of this work	198—298
Method of weaving Tapestry	298
Of the manufacture of Paper Hangings	304

PART I.

Of Inks, Cements, and Sealing-Wax.

CHAP. I.

Of Inks.

SECT. I.

Of Inks in general.

INKS are fluid compounds, intended to form characters, shades, lines, scrolls, or some other kinds of figures, on proper grounds of paper, parchment, vellum, or such other substance as may be fit to receive them. They are of two kinds, *writing ink*, and *printing ink*; which, besides their manner of use, differ in this, that the first is always formed in some aqueous fluid, the latter in oil.

Water being the vehicle in writing ink, it is necessary, besides the tinging substances that are used to give the proper colour to it, to add some mucilaginous or viscid body, to prevent its running or spreading on the paper or parchment further than the lines necessary for forming the figure of the letters, characters, or lines of the writing or drawing. This intention has been found to be best answered by the addition of gum Arabic, which indeed appears to have been applied to this pur-

pose ever since the first introduction into use of ink formed of water. But to avoid using so much of the gum as may render the ink too thick, alum is added by some in the same intention, as it weakens the mutual attraction of the paper or parchment, and the water of the ink, and therefore prevents its flowing so freely from the pen.

Writing inks have been invented of various colours, but none are in general used except black and red, tho' there are many yellow tinges extremely well suited to the composition of ink. But the lightness of yellow making its effect on a white ground so little prevalent, is a good reason, nevertheless, for preferring red to it, where any colour besides black is wanted.

For printing inks likewise, the oil requires a previous preparation, as well to render it more unctuous, as to make it dry the quicker. But this preparation being the reducing the oil to the state where it is called drying oils in painting, which has before been fully shewn and explained in treating of oil as a vehicle for painting, it will be needless to repeat any particulars relating to it again in the case of inks.

S E C T. II.

Of Black Writing Ink.

THE tinging matter of black inks is most generally borrowed from two substances, galls and logwood. For though Roman vitriol, coal of various substances, and other tinging or coloured bodies, have been sometimes used, yet they are either so much less efficacious, or so attended with discordant qualities, as renders the galls, especially when conjoined with the logwood, greatly preferable to them. Galls are therefore by much the most common tinging substance employed for forming ink, though the colouring matter they contain is not in its natural state black; but being extracted by water in the form of a tincture or a fusion, requires to be conjoined with precipitated iron, in order to render it so. For this reason green vitriol or copperas is always added to the infusion or tincture of the galls, and

being constituted of iron, combined with the vitriolic acid, and analized by the gummous matter that makes the tinging part of the galls, affords iron in that state proper for striking the black colour.

The nicety in the composition of inks lies in adequating the proportion of the vitriol to the galls; for, in case of great error in this particular, the ink turns brown with time, and sometimes wholly disappears, as there may be found too many instances amongst the modern, as well as older writings. The adjusting the respective quantities of these two ingredients, cannot, nevertheless, be reduced to any certain rules that will always avail in every instance, because the difference in the strength of different parcels of the galls, and in the incidental circumstances of extracting the tinging matter from them, makes a great variation in the essential proportion with regard to the vitriol. This incertitude with respect to the durableness of the colour of the ink, as far as it depends on the galls, has introduced the use of logwood, as an auxiliary tinge; for this wood affords a gum soluble in water, that when struck with the precipitated iron, as well as any other alkaline body, becomes a deep purple or blue tinge; which, though not of itself strong enough to form a perfect ink, is yet of a sufficient force, combined with the brown of the iron, to support a legible colour in the ink, even if the galls fail and wholly lose their tinging power, as frequently happens; and, indeed, when no such miscarriage occurs, the purplish blue tinge of the logwood, conjoined with the black of the galls, gives a beauty and strength to the colour of the ink.

Privet berries have been likewise used in the same intention as the logwood, as they afford by pressure, when ripe, a juice of a very strong purple colour.

In order to make the ink work more freely, and have a greater body and more glossy appearance, sugar and sugar-candy, are frequently added in a small proportion. But there is another substance that produces this effect in a more perfect manner and greater degree, which is the pomegranate peel, which, added to the other ingredients, gives a shining appearance, and improves highly the effect of the ink.

Alum, as I before observed, is sometimes added to the ink, but it is not necessary where the pomegranate peel is used.

There are many recipes for forming ink of wine or vinegar, instead of water, though the practice is certainly very erroneous; for the wine, though it does not equally obstruct the effect of the galls as the vinegar, does yet in no degree contribute to the improvement of the qualities required in black ink; the vinegar, however, is not only unnecessary, but really detrimental to the effect of the galls, as it neutralizes the iron, and consequently destroys the tinging property of the galls which depends upon it, and therefore occasions a very large quantity to be requisite for the producing even any black at all in the ink. This quality of the vinegar may be easily demonstrated by the mixing a small proportion of it with any ink tinged only with galls, for it will instantly destroy the blackness, and render the ink either brown or colourless like water.

Spirit of wine and brandy are sometimes also added to ink, to prevent its growing mouldy; but care must be taken that the spirit be not commixt with much of the acid used by the distillers in the rectification of it, for otherwise it will weaken the ink, and sometimes, as I have seen instances, even wholly destroy the colour.

COMPOSITION OF COMMON BLACK INK.

“ Take one gallon of soft water, and pour it boiling
“ hot on one pound of powdered galls put into a proper
“ vessel. Stop the mouth of the vessel, and set it in the
“ sun in summer, or in winter where it may be warmed
“ by any fire, and let it stand two or three days. Add
“ then half a pound of green vitriol powdered, and,
“ having stirred the mixture well together with a wooden
“ spatula, let it stand again for two or three days, re-
“ peating the stirring, when add further to it five ounces
“ of gum Arabic dissolved in a quart of boiling water;
“ and lastly, two ounces of alum, after which the ink
“ should be strained through a coarse linen cloth for
“ use.”

The galls should be good, or the ink will fail, as it very frequently does from an error in this point. The marks of their goodness is the appearing of a bluish colour and feeling heavy. Where they are light in weight, and of a whitish brown colour, without any blue, they should be rejected, or a greater proportion should be used.

In all the recipes I have ever seen for ink, the gum Arabic is ordered to be put undissolved into the mixture of water, galls, and vitriol; but however common, it is certainly a very injudicious practice; for as gum Arabic is with some difficulty dissolved in simple water, and much more so in such as is acidulated by salts like the vitriol, and clogged likewise with the solid part of the galls and the precipitated iron, it is certainly much better to make a solution of it in part of the water of which the ink is to be formed, previously to its being commixt with the other ingredients, which would otherwise, in spite of the most frequently repeated stirrings, keep it at the bottom of the vessel, and prevent its being ever wholly freed from them and dissolved.

Boiling either the infusion of the galls, or the mixture after the addition of the vitriol, has likewise been frequently ordered and practised. It is nevertheless not only needless, but injurious to the preparation of the ink, as it can have no effect on the vitriol, besides conducing to the solution of it, which is easily effected in the proportion of water proper to be used without any heat; and with respect to the galls, their tinging power residing in an essential oil that is volatile, and will rise with less heat than that of boiling water, it is necessarily lessened by the evaporation: and consequently, though more of it may be extracted from the galls, yet less will be retained in the fluid than if infusion with a gentle heat be used instead of decoction.

Having thus given the best means of preparing black ink in the common and simplest manner, I will subjoin a recipe for forming the most perfect ink, which will be, nevertheless, found very little more expensive and troublesome than the common kind, though greatly superior both with respect to the beauty of the colour, and the security of its standing well.

IMPROVED COMPOSITION OF BLACK WRITING INK

“ Take a gallon of soft water, and boil in it a pound of chips of logwood for about half an hour. Take the decoction then off the fire, and pour it from the chips while boiling hot on a pound of the best Aleppo galls beaten to powder, and two ounces of pomegranate peels put into a proper vessel. After having stirred them well together with a wooden spatula for some time, place them in the sunshine in summer, or within the warmth of any fire if in winter, for three or four days, stirring the mixture again as often as may be convenient. At the end of that time add half a pound of green vitriol powdered, and let the mixture remain four or five days more, stirring it as frequently as may be convenient, and then add further four ounces of gum Arabic dissolved in a quart of boiling water, and after giving the ink some time to settle, strain it off from the dregs, through a coarse linen cloth, and kept it well stopp’d for use.”

If the ink be desired to shine more, the proportion of the pomegranate peel must be increased; and in the country, where the logwood cannot be so easily procured, a pound of ripe privet berries cannot be substituted for it.

In order to secure this ink from growing mouldy, a quarter of a pint or more of spirit of wine may be added; but to prevent its containing any acid, which may injure the ink, a little salt of tartar or pearl-ashes should be added previously, and the spirit poured off from it, which will render it innocent with regard to the colour of the ink.

These are the best recipes for the kinds of ink now in use; but for the sake of those who are fond of variety, I will add one recipe for an ink prepared on other principles, formerly sometimes used, and at first invented probably on account of that failure of the colour of the ink made of galls, which might be experienced, particularly when injudiciously prepared.

COMPOSITION FOR A BLACK WRITING INK WITH-
OUT GALLS OR GREEN VITRIOL.

" Infuse a pound of pomegranate peels, broke to a gross powder, for twenty-four hours in a gallon and a half of water, and afterwards boil the mixture till one-third of the fluid be wasted. Add then to it one pound of Roman vitriol, and four ounces of gum Arabic powdered, and continue the boiling till the vitriol and gum be dissolved, after which the ink must be strained through a coarse linen cloth, and will be fit for use."

This ink is somewhat more expensive, and yet not near so good in hue as that made by the preceding method; but the colour which it has is not liable to vanish or fade in any length of time, and therefore very curious persons may have some satisfaction in being possessed of such a recipe.

PREPARATION OF A POWDER FOR FORMING GOOD
BLACK INK EXTEMPORANEOUSLY BY THE ADDI-
TION OF WATER.

" Infuse a pound of galls powdered, and three ounces of pomegranate peels, in a gallon of soft water for a week, in a gentle heat, and then strain off the fluid through a coarse linen cloth. Add then to it eight ounces of vitriol dissolved in a quart of water, and let them remain for a day or two, preparing in the mean time a decoction of logwood, by boiling a pound of the chips in a gallon of water, till one third be wasted, and then straining the remaining fluid while it is hot. Mix the decoction and the solution of galls and vitriol together, and add five ounces of gum Arabic, and then evaporate the mixture over a common fire to about two quarts, when the remainder must be put into a vessel proper for that purpose, and reduced to dryness in *balneo mariæ*; that is, by hanging the vessel in boiling water. The mass left, after the fluid is wholly exhaled, must be well powdered; and, when wanted for use, may be converted into ink by the addition of water."

It was formerly the practice in compounding the portable inks, to mix the galls in substance with the other ingredients, and form the composition only of them with vitriol and gum Arabic powdered together. But besides the clogging and fouling it with the ligneous matter of the galls, there could be no dependence on the standing of ink so imperfectly formed.

Compositions were also formerly made for portable, or extemporaneous inks, without galls or vitriol, of one of which the following is a recipe :

“ Take half a pound of honey, and the yolk of an egg, and mix them well together. Add two drams of gum Arabic finely levigated, and thicken the whole with lamp black to the consistence of a stiff paste, which, being put to a proper quantity of water, may be used as ink.”

S E C T. III.

Preparation of Red Writing Ink.

“ TAKE of the raspings of Brasil wood a quarter of a pound, and infuse them two or three days in vinegar, which should be colourless, where it can be so procured. Boil the infusion then an hour over a gentle fire, and afterwards filter it, while hot, thro’ paper laid in an earthen cullender. Put it again over the fire, and dissolve in it, first half an ounce of gum Arabic, and afterwards of alum and white sugar, each half an ounce.”

Care should be taken that the Brasil wood be not adulterated with the Brasiletto or Campeachy (commonly called Peachy) wood, which is mostly the case when it is ground ; and though a very detrimental fraud in all instances of the application of Brasil wood to the forming bright red colours, cannot yet be perceived after the mixture of the raspings, but by trial in using them, it is therefore much the best way, when wanted for purposes like this, to procure the true Brasil wood in pieces, and to scrape it with a knife, or rasp it with a very bright file, (but all rust of iron must be carefully

avoided) by which means all possibility of sophistication is of course prevented.

Red ink may likewise be prepared by the above process, of white wine instead of vinegar; but it should be sour, or disposed to be so, otherwise a third or fourth of vinegar should be added, in order to its taking the stronger tincture from the wood. Small beer has been sometimes used for the same purpose, but the ink will not be so bright, and when it is used, vinegar should be added, the quantity of gum Arabic diminished, and the sugar wholly omitted.

PREPARATION OF RED INK FROM VERMILION.

“ Take the glair of four eggs, a tea spoonful of
 “ white sugar or sugar-candy beaten to powder, and
 “ as much spirit of wine, and beat them together till
 “ they be of the consistence of oil; then add such a
 “ proportion of vermilion as will produce a red colour
 “ sufficiently strong, and keep the mixture in a small
 “ phial or well-stopt ink bottle for use. The composi-
 “ tion should be well shaken together before it be
 “ used.”

Instead of the glair of eggs, gum water is frequently used; but thin size, made of isinglass with a little honey, is much better for the purpose.

SECT. IV.

Preparation of Green Writing Ink.

“ TAKE an ounce of verdigrise, and having pow-
 “ dered it, put it to a quart of vinegar, and,
 “ after it has stood two or three days, strain off the
 “ fluid; or, instead of this, use the crystals of verdigrise
 “ dissolved in water; then dissolve, in a pint of either
 “ of these solutions, five drams of gum-Arabic, and two
 “ drams of white sugar.”

S E C T. V.

Preparation of Yellow Writing Ink.

“ **B**OIL two ounces of the French berries in a quart of water, with half an ounce of alum, till one-third of the fluid be evaporated, and then dissolve in it two drams of gum Arabic, and one dram of sugar, and afterwards a dram of alum powdered.”

S E C T. VI.

Of Printing Inks.

PRINTING inks, as I before intimated in the general account of inks, are compounded of drying oil, and some pigment of the colour required in the ink. The goodness of the ink depends, therefore, both on the composition of the drying oil, and the perfection of the colouring pigment. At present, however, printing ink is seldom used of any other colour than black or red; and, except in the case of engravings on copperplates, the common drying oil, mixed with crude linseed oil and lamp black, is made to answer the purpose. The best proportion of the lamp black to the oil is said to be about an ounce to a pound, and the rest must depend on the goodness of the materials used.

For the more perfect black printing ink, proper for copperplates and such other nice purposes, a drying oil prepared from nut oil, and the German black made at Frankfort, and some other places, from the lees of wine, should be used. The most approved method of preparing this oil, and mixing it with the black, is as follows:

PREPARATION OF BLACK PRINTING INK FOR ENGRAVINGS ON COPPER, OR OTHER NICE PURPOSES.

“ Take any quantity of the best nut oil, and put it into an iron pot with a cover well fitted to it, of which

" pot it must fill only two-thirds. Place it on a fire,
 " and, having put on the cover, let it continue in that
 " state till it makes an ebullition, when it must be very
 " well stirred to prevent its boiling over. Suffer it then
 " to catch fire, or kindle it by a lighted paper, and
 " when it flames take it from the fire, and place it in a
 " corner of the chimney, where let it continue to burn
 " half an hour, frequently stirring it. Extinguish then
 " the flame, by putting the cover on the pot; or if that
 " be not effectual, by putting a wet cloth over it. This
 " produces the weak oil which has the principal part in
 " the composition of the ink. But a strong oil must
 " likewise be prepared by the same means, only instead
 " of extinguishing the flame at the end of half an hour,
 " it must be continued till the oil be rendered very
 " thick and glutinous, which must be examined by tak-
 " ing a little out of the pot, and suffering it to cool;
 " when, if it be found to be extremely adhesive and
 " ropy, so as to be drawn out in long threads, it is
 " sufficiently burnt, and the flame must be put out. This
 " is the strong oil, of which a proportion is to be used
 " along with the other in the printing ink. * Having
 " prepared these oils, take half a pound of the Frank-
 " fort, or any other good black, and grind it with the
 " addition of only so much of the weak oil as is neces-
 " sary to make it work on the stone, which will be ge-
 " nerally something less than half the weight. The
 " whole being first incorporated together, and after-
 " wards thoroughly well mixt by a second grinding,
 " (having only a small quantity on the stone at a time)
 " a quantity of the strong oil must be added, which
 " may be as much as is equal to the size of a small hen's
 " egg. It will then be fit for use, and must be put into
 " a proper pot, and covered with paper or leather."

There are some who add an onion or crust of bread
 to the oil while boiling, in order to take off the greasi-
 ness; but the burning will sufficiently do that office,
 when properly managed.

Instead of Frankfort, or other kinds of black com-
 monly used, the following composition may be substi-
 tuted, and will form a much deeper and more beautiful
 black than can be obtained by any other method.

“ Take of the deepest Prussian blue five parts, and
 “ of the deepest-coloured lake and brown pink each
 “ one part. Grind them well with oil of turpentine,
 “ and afterwards with the strong and weak oils in the
 “ manner and proportion above directed.”

The colours need not be bright for this purpose, but they should be the deepest of the kind, and perfectly transparent in oil, as the whole effect depends on that quality.

OF THE STUCHUM, OR PERPETUAL INK OF THE ANCIENTS FOR ENGRAVEN LETTERS ON STONE.

This ink (as it was called from its application) was formed by mixing about three parts of pitch with one part of lamp black, and making them incorporate by melting the pitch. With this composition, used in a melted state, the letters were filled, and would, without extraordinary violence, endure as long as the stone itself.

S E C T. VII.

Of Secret Inks.

A GREAT variety of methods have been invented for making secret letters, but the most common are to write with a colourless fluid, which may be made to assume the quality of ink, either by embrocating or moistening the paper containing the writing with some other fluid, or by putting it into a gentle heat, or by immersing it in water. But many other experiments may be found for forming invisible letters, which may be occasionally rendered legible by applying the proper means, of which, after speaking of the more common methods, I will subjoin an instance or two.

For preparing inks, which may be made to appear occasionally, the following methods may be pursued :

“ Take an ounce of galls powdered, and infuse them
 “ three or four days in half a pint of water. Pour off
 “ the clear fluid, and dissolve in it a dram of gum Arabic. Write with this fluid, and, when it is desired
 “ to render the writing visible, rub the paper over with

" a solution of green vitriol or copperas, formed by
 " dissolving half an ounce of the vitriol in half a pint
 " of water."

Or otherwise,

" Take two ounces of quick-lime, and one ounce of
 " orpiment, and add them to a pint of water. Let
 " them stand in a gentle heat, often shaking the vessel,
 " for some hours, or longer if it be convenient, and then
 " pour off the fluid. Make, in the mean time, a solu-
 " tion of sugar of lead, by dissolving three drams of it
 " in two ounces of water, and with this solution write
 " on paper what is required. When it is desired to
 " render this writing visible, embrocate or rub over the
 " paper with the fluid taken off from the lime and or-
 " piment, and the letters will immediately appear of a
 " strong blackish brown colour."

" Take any small quantity of the calcined ore of
 " bismuth, and dissolve it in *aqua fortis*: then, having
 " made a strong solution of sea salt in water, add of
 " this, to the solution of the bismuth in the *aqua fortis*,
 " one-fourth of its weight; evaporate then this mix-
 " ture till it be dry, or nearly so: there will then re-
 " main a reddish salt, which, being again dissolved in
 " water, forms a sympathetic ink; for, if letters or cha-
 " racters be written with it on common writing paper,
 " they will disappear when dry or cold; but if the pa-
 " per be heated, they will shew themselves of a green
 " colour very legible. On the paper's becoming cold,
 " they will again vanish, but may be renewed at plea-
 " sure by heating it again. If a solution of nitre or
 " borax be used instead of a sea salt, the writing, when
 " warmed, will appear of a rose colour instead of
 " green."

In order to make it more easy to write with the co-
 lourless fluids, they may be mixed with burnt corks,
 very black, or charcoal ground to a fine powder. This
 will render the writing thin and visible as if ink had
 been used; but the paper may be again made to appear
 blank, by rubbing off the black powder, which may be
 easily done by a soft brush or linen rag. Where, ne-
 vertheless, any black powder is mixed with the fluid,
 the gum Arabic, as directed in the first recipe, must be

omitted, otherwise the powder will be so cemented to the paper as not to be easily taken off from it, without injuring the invisible writing under it.

Invisible letters, which may occasionally be rendered apparent, by holding the paper on which they are written to the fire, may be made by writing with the juice of lemons, or of onions; or with sal ammoniacum finely powdered and tempered with water; or by the fluid which may be pressed from the mixture of onion, urine, and salt, ground together till they become of an unctuous consistence.

Letters also may be formed, which are invisible till the paper on which they are written be immersed in water. The easiest method of doing which is by writing with a solution of roch alum, and, when it is desired to have the letters appear, placing the paper in an horizontal situation in a basin full of water, where after it has remained some time, the writing will shew itself in a white character very distinctly. There are other methods of doing the same, but as they are more complex and troublesome than this, it is needless to insert them.

There is a very neat and easy method of using a blank writing, that may be made visible occasionally; which is, the applying the manner of gilding with the gold armoniac (as it was formerly called) to this purpose. It must be done by dissolving gum ammoniacum in water, to which some juice of garlic and a little gum Arabic should be added, and then writing with the mixture, which writing may be rendered visible at any time by breathing on the paper, and then laying a leaf of gold over the part written upon, which being compressed to the paper, and afterwards gently rubbed with a camel's hair brush, or a little cotton, will leave the writing perfectly gilt.

CHAP. II.

Of Cements.

CEMENTS require to be of very various compositions, and different with respect to the nature of the ingredients, according to the different manner in which they are to be applied, and the substances they are to conjoin. The kinds of cement used for common purposes pass under the denomination of glues, sizes, pastes, and lutes; but some that are used for extraordinary occasions retain only the general name of cements.

OF COMMON GLUE.

Common glue is formed by extracting the gelatinous part of cuttings or scraps of coarse leather, or the hides of beasts; but this being carried on as a gross manufacture by those who make it their proper business, the giving a more particular account of the method practised would be deviating from the proper design of this work.

PREPARATION OF ISINGLASS GLUE.

“Isinglass glue is made by dissolving beaten isinglass in water by boiling, and, having strained it through a coarse linen cloth, evaporating it again to such a consistence, that, being cold, the glue will be perfectly hard and dry.”

A great improvement is said to be made in this glue by adding spirit of wine or brandy to it after it is strained, and then renewing the evaporation till it gain the due consistence. Some soak the isinglass in the spirit or brandy for some time before it is dissolved, in order to make the glue, and add no water, but let the spirit supply the place of it; but it is not clear, from trial, that either of these practices render the glue better.

This isinglass glue is far preferable to common glue for nicer purposes, being much stronger, and less liable to be softened either by heat or moisture.

PREPARATION OF PARCHMENT GLUE.

“ Take one pound of parchment, and boil it in six
 “ quarts of water till the quantity be reduced to one
 “ quart; strain off the fluid from the dregs, and then
 “ boil it again till it be of the consistence of glue.”

The same may be done with glovers' cuttings of leather, which make a colourless glue, if not burnt in the evaporation of the water.

PREPARATION OF A VERY STRONG COMPOUND GLUE.

“ Take common glue in very small or thin bits, and
 “ isinglass glue, and infuse them in as much spirit of
 “ wine as will cover them, for at least twenty-four
 “ hours. Then melt the whole together, and, while
 “ they are over the fire, add as much powdered chalk
 “ as will render them an opaque white.”

The infusion in the spirit of wine has been directed in the recipes given for this glue; but the remark on the use of it in the preceding article will hold good also in this, and the mixture may be made with water only.

PREPARATION OF A VERY STRONG GLUE THAT WILL RESIST MOISTURE.

“ Dissolve gum sandarac and mastic, of each two
 “ ounces, in a pint of spirit of wine, adding about an
 “ ounce of clear turpentine: then take equal parts of
 “ isinglass and parchment glue, made according to the
 “ directions in the preceding article, and, having beat-
 “ en the isinglass into small bits, as for common uses,
 “ and reduced the glue to the same state, pour the so-
 “ lution of the gums upon them, and melt the whole in
 “ a vessel well covered, avoiding so great a heat as that
 “ of boiling water. When melted, strain the glue
 “ through a coarse linen cloth, and then putting it again
 “ over the fire, add about an ounce of powdered
 “ glass.”

This preparation may be best managed in *balneo Mariae*, which will prevent the matter burning to the vessel, or the spirit of wine from taking fire, and indeed it is better to use the same method for all the evapora-

tions of nicer glues and sizes; but in that case, less water than the proportion directed should be added to the materials.

A very strong glue, that will resist water, may be also made by adding half a pound of common glue or isinglass glue to two quarts of skimmed milk, and then evaporating the mixture to the due consistence of the glue.

PREPARATION OF LIP GLUE, FOR EXTEMPORANEOUSLY CEMENTING PAPER, SILK, AND THIN LEATHER, &c.

"Take of isinglass glue and parchment glue, each one ounce, of sugar-candy and gum tragacanth, each two drams. Add to them an ounce of water, and boil the whole together till the mixture appear, when cold, of the proper consistence of glue. Then form it into small rolls, or any other figure that may be most convenient."

This glue may be wet with the tongue, and rubbed on the edges of the paper, silk, &c. that are to be cemented, and will, on their being laid together, and suffered to dry, unite them as firmly as any other part of the substance.

OF SIZES.

Common size is manufactured in the same manner, and generally by the same people, as glue. It is indeed glue left in a moister state, by discontinuing the evaporation before it is brought to a dry consistence, and therefore further particulars respecting the manufacture of it are needless here.—Isinglass size may also be prepared in the manner above directed for the glue, by increasing the proportion of the water for dissolving it, and the same holds good of parchment size. A better sort of the common size, which may be likewise made by treating cuttings of glovers' leather in the same manner.

OF PASTES.

Pastes for cementing is formed principally of wheaten flour boiled in water till it be of a glutinous or viscid consistence.

It may be prepared of those ingredients simply for common purposes; but when it is used by bookbinders, or for paper hangings to rooms; it is usual to mix a fourth, fifth, or sixth of the weight of the flour of powdered resin, and where it is wanted still more tenacious, gum Arabic, or any kind of size may be added.

In order to prevent the paste used for hanging rooms with paper, or where it is employed in any other way that may render it subject to such accidents, from being gnawed by rats and mice, powdered glass is sometimes mixt with it; but the most effectual and easy remedy is to dissolve a little sublimate, in the proportion of a dram to a quart, in the water employed for making the paste, which will hinder not only rats and mice, but any other kind of vermin and insects from preying on the paste.

OF LUTES.

Lutes are cements employed for making good the joints of glasses put together, or other such purposes in chemical operations. In a general view, the preparation of them properly belongs to the art of chemistry only; but as they are nevertheless sometimes used in other arts, it may be expedient to shew here the manner of compounding them.

In the making good junctures, where the heat is not sufficient to burn paper or vegetable substances, the following mixture, which is easily made, will effectually answer the purpose. Take a mixture of linseed meal, or wheaten flour and whiting, in the proportion of one part of the first to two of the last, tempered with a solution of gum Senegal or Arabic in water, and spread upon the joint, a narrow piece, smeared with the same, being put over it and pressed close. A piece of bladder smeared with gum water or the glair of eggs, and fitted to the glasses over the joint, will also answer the same end; but in the rectification of spirit of wine, or other such volatile substances, where the waste made by the escape of the vapour may be material, a stronger lute formed of quick-lime, tempered to a proper consistence with drying oil, should be used. This mixture should be made at the time it is wanted, as it very soon be-

comes dry and untractable, and great care must be taken, where it is employed, to manage the heat in such a manner that the vapour may not rise so fast as to heat the vessels beyond the due point; for this lute renders the glasses joined together by it as one entire body, and will resist the expansive force of the vapour to so great a degree that the glasses will frequently burst before it will give way.

Where lute is to be used in places liable to be so heated as to burn vegetable or animal substances, it may be thus compounded: Take two parts of green vitriol calcined to redness, one part of the scoria or clinkers of a smith's forge well levigated, and an equal quantity of Windsor loom or Sturbridge clay dried and powdered; temper them to a proper consistence with the blood of any beast, some short hair, of which the proportion may be as a twentieth part to the whole, being beaten up with them, and spread them over the juncture. In cases of little importance, a composition of sand, clay, and dung of horses, tempered with water, may be used.

PREPARATION OF CEMENT FOR JOINING BROKEN GLASSES, CHINA, &c.

The cement which has been most approved for uniting glass, china, or earthen-ware, as also the parts of metalline bodies (where soldering is not expedient) is thus prepared:

“ Take two ounces of good glue, and steep it for a night in distilled vinegar; boil them together the next day, and having beaten a clove of garlic with half an ounce of ox-gall into a soft pulp, strain the juice through a linen cloth, using pressure, and add it to the glue and vinegar. Take then of sandarac powdered and turpentine, each one dram, and of sarcocol and mastic powdered, each half a dram, and put them into a bottle with an ounce of highly-rectified spirit of wine. Stop the bottle, and let the mixture stand for three hours in a gentle heat, frequently shaking it. Mix this tincture also with the glue while hot, and stir them well together with a stick or tobacco-pipe, till part of the moisture be evaporated, and then take the composition from the fire, and it

“ will be fit for use. When this cement is to be applied, it must be dipt in vinegar, and then melted in a proper vessel with a gentle heat, and if stones are to be cemented, it is proper to mix with it a little powdered tripoli or chalk; or, if glass is to be conjoined, powdered glass should be substituted.”

I see no reason why common vinegar should not be equally proper for this purpose with the distilled, nor indeed am I very certain that vinegar improves at all the cementing property of the composition.

For the uniting the parts of broken china or earthenware vessels, as also glass where the rendering the joint visible is not of consequence, the following composition, which is much more easily prepared, may be substituted for the foregoing:

“ Take an ounce of Suffolk cheese, or any other kind devoid of fat; grate it as small as possible, and put it, with an equal weight of quick-lime, into three ounces of skimmed milk: mix them thoroughly together, and use the composition immediately.”

Where the broken vessels are for service only, and the appearance is not to be regarded, the joints may be made equally strong with any other part of the glass, by putting a slip of thin paper, or linen, smeared with this cement, over them, after they are well joined together by it. This method will make a great saving in the case of glasses employed for chemical, or other similar operations.

A cement of the same nature may be made by tempering quick-lime with the curd of milk, till it be of a due consistence for use. The curd, in this case, should be as free as possible from the cream or oil of the milk. On this account it should be made of milk from which the cream has been well skimmed off, or the kind of curd commonly sold in the markets, made of whey, and the milk from which butter has been extracted, commonly called butter-milk. This cement should be used in the same manner as the preceding; and they may be applied to stones, marble, &c. with equal advantage as the more compound one above given, and is much more easily and cheaply prepared.

Drying oil with white lead is also frequently used for cementing china and earthen ware; but where it is not necessary the vessels should endure heat or moisture, singlass glue, with a little tripoli or chalk, is better.

REPARATION OF COMMON CEMENT FOR JOINING ALABASTER, MARBLE, PORPHYRY, OR OTHER STONES.

"Take of bees wax two pounds, and of resin one pound; melt them, and add one pound and a half of the same kind of matter powdered as the body to be cemented is composed of, strewing it into the melted mixture, and stirring them well together, and afterwards kneading the mass in water, that the powder may be thoroughly incorporated with the wax and resin. The proportion of the powdered matter may be varied, where required, in order to bring the cement nearer to the colour of the body on which it is employed."

This cement must be heated when applied, as must also the parts of the subject to be cemented together, and care must be taken, likewise, that they be thoroughly dry.

It appears to me that the proportion of the bees wax is greater than it ought to be; but I receive this recipe from too good an authority to presume to alter it. When this composition is properly managed, it forms an extremely strong cement, which will even suspend a projecting body of considerable weight, after it is thoroughly dry and set, and is therefore of great use to all carvers in stone, or others who may have occasion to join together the parts of bodies of this nature.

OF CEMENTS FOR ROCK-WORK, RESERVOIRS, AND OTHER SUCH PURPOSES.

A variety of compositions are used as cements for purposes of this kind, in the application of which, regard should be had to the situation where they are employed with respect to moisture and dryness, as well as to the magnitude of the bodies to be conjoined together, or the vacuities or fissures that are to be made good.

Where a great quantity of cement is wanted for coarse uses, the coal-ash mortar (or Welsh tarras, as it is called) is the cheapest and best, and will hold extremely well, not only where it is constantly kept wet or dry, but even where it is sometimes dry, and at others wet; but where it is liable to be exposed to wet and frost, this cement should, at its being laid on, be suffered to dry thoroughly before any moisture have access to it; and, in that case, it will likewise be a great improvement to temper it with the blood of any beast.

This mortar or Welsh tarras must be formed of one part lime and two parts of well-sifted coal-ashes, and they must be thoroughly mixt by being beaten together; for, on the perfect commixture of the ingredients, the goodness of the composition depends.

Where the cement is to remain continually under water, the true tarras is commonly used, and will very well answer the purpose. It may be formed of two parts of lime, and one part of plaister of Paris, which should be thoroughly well beaten together, and then used immediately.

For the fixing shells, and other such nice purposes, putty is most generally used. It may be formed for this purpose of quick-lime and drying oil, mixed with an equal quantity of linseed oil; or, where the drying quicker is not necessary, it may be made with lime and crude linseed oil, without the drying oil.

The stone cement, prepared as above of the bees wax and resin, is also an extremely good composition for this purpose. But resin, pitch, and brick-dust, in equal parts, melted together and used hot, are much the cheapest cement for shell-work, and will perform that office very well, provided the bodies they are to conjoin be perfectly dry when they are used.

CHAP. III.

Of Sealing-Wax.

SECT. I.

Of Sealing-Wax in general.

SEALING-WAX is a cement formed of the resins, gum resins, or bodies of a similar nature, tinged with some pigment to give the colour desired. It ought to be capable of resisting moisture, and of being melted growing soft by a gentle heat, and becoming hard and tenacious on its again growing cold.

Most of the resinous bodies, as seed and shell-lac, asphaltic, sandarac, gum gutta, gamboge, resin, turpentine, and bees wax, have been applied to this purpose, and even sulphur (though improperly, from its disagreeable fumes on burning) has been added. There are two kinds of sealing-wax in use, the one HARD, intended for sealing letters, and other such purposes, where only a thin body can be allowed;—the other SOFT, designed for receiving the impressions of seals of office to charters, patents, and other such instruments of writing.

As there is with respect to the hardness of wax a better and more common kind in use, I will give one good recipe for each sort, but shall omit all those ingredients, which, though formerly used, produce no effect but what will be equally found in these simpler and cheaper compositions.

S E C T. II.

Compositions of Hard Sealing-Wax of various Colours.

COMPOSITION OF THE BEST HARD RED SEALING-WAX.

“ TAKE of shell-lac, well powdered, two parts, of
 “ resin and vermilion, powdered also, each one
 “ part: mix them well together, and melt them over a
 “ gentle fire, and when the ingredients seem thoroughly
 “ incorporated, work the wax into sticks. Where
 “ shell-lac cannot be procured, seed-lac may be substituted
 “ for it.”

The quantity of vermilion, which is much the dearest ingredient, may be diminished without any injury to the sealing-wax, where it is not required to be of the highest and brightest red colour; and the resin should be of the whitest kind, as that improves the effect of the vermilion.

Instead of resin, boiled turpentine may be substituted with great advantage to the qualities of the wax. The preparation of it is thus: “ Take any quantity of Venice turpentine; and, having put water to it, boil
 “ them together till the turpentine becomes hard, and
 “ ceases to stick to the fingers when cold.”

Care should be taken, in making the wax, not to use too strong a fire in the melting the ingredients, and to remove them out of the heat as soon as they will be commixed; for, if any evaporation of the more volatile parts of the shell or seed-lac, or resin, be suffered, the wax is rendered proportionably brittle.

COMPOSITION OF A COARSER HARD RED SEALING-WAX.

“ Take of resin two parts, and of shell-lac, vermilion,
 “ and red lead, mixt in the proportion of one part of
 “ the vermilion to two of the red lead, each one part,
 “ and treat them according to the directions for the
 “ foregoing composition.”

For a yet cheaper kind, the vermilion may be wholly omitted; and in the case of very coarse uses, the shell-lac also.

COMPOSITION OF THE BEST HARD BLACK SEALING-WAX.

Proceed as for the best hard red wax, only instead of the vermilion substitute the best ivory black.

COMPOSITION OF A COARSER HARD BLACK SEALING-WAX.

Proceed as in the composition for the coarser hard red wax; only, instead of the vermilion and red lead, substitute the common ivory black.

COMPOSITION OF HARD GREEN SEALING-WAX.

Proceed as in the above; only, instead of vermilion, use verdigrise powdered; or, where the colour is required to be bright, distilled or crystals of verdigrise.

COMPOSITION OF HARD BLUE SEALING-WAX.

As the above; only changing the vermilion for smalt well powdered; or, for a light blue, verditer may be used; as may also, with more advantage, a mixture of both.

COMPOSITION OF YELLOW HARD SEALING-WAX.

As the above; only substituting masticot; or, where a brighter colour is desired, turpeth mineral, instead of the vermilion.

COMPOSITION OF HARD PURPLE SEALING-WAX.

As the red; only changing half the quantity of the vermilion for an equal or greater proportion of smalt, according as the purple is desired to be blue or red.

SECT. III.

Compositions of Soft Sealing-Wax.

COMPOSITION OF UNCOLOURED SOFT SEALING-WAX.

“TAKE of bees wax one pound, of turpentine three ounces, and of olive oil one ounce: Place them in a proper vessel over the fire, and let them boil for some time, and the wax will be then fit to be formed into rolls or cakes for use.”

COMPOSITION OF RED, BLACK, GREEN, BLUE, YELLOW, AND PURPLE SOFT SEALING-WAX.

“Add to the preceding composition, while boiling, an ounce or more of any ingredients directed above for colouring the hard sealing-wax, and stir the matter well about, till the colour be thoroughly mixed with the wax.”

The proportion of the colouring ingredients may be increased, if the colour produced by that here given be not found strong enough.

SECT. IV.

Of the manner of forming Sealing Wax into Sticks, Balls, Rolls, or Cakes; and of Perfuming it.

THE hard sealing-wax is generally formed into sticks, as the most expedient figure for sealing letters; but for particular purposes it is sometimes also made up in balls. The soft wax is promiscuously wrought into rolls, or cakes; as either are equally suitable to the uses it is applied to.

In order to the forming hard sealing-wax into sticks, a copperplate, or stone, big enough to allow of its being rolled out to a due length, with a rolling-board, lined with copper or block tin, having a proper handle, is wanting, as likewise a small portable earthen furnace

or stove for burning charcoal. The copperplate, or stone, must have a very smooth surface, and may be in dimensions from two to three feet long, and about two feet broad; and it must be so fixt as to admit of its being kept of a moderate heat while it is used. The rolling-board may be about a foot long, and about eight or ten inches in breadth, and the lining of block-tin, or copper, ought to be polished.

The furnace, or stove, heated with charcoal, is also necessary for this purpose. It is made in the shape of a water-pail, with bars near the bottom for supporting the coal, and notches at the top of the sides for putting the wax over the fire: but it is needless to be more particular with regard to the construction of these furnaces, or stoves, because they are to be had ready made at the earthen-ware shops.

The manner of using these several implements for the forming the wax into sticks, is this: Take a proper quantity of the wax out of the vessel in which it is prepared, as soon as the ingredients appear duly commixt, and put it on the plate or stone; where, having drawn it out into a longish figure, it must be rolled with the board upon the plate or stone till it be of the thickness of which the sticks are required. It must then be cut into proper lengths or sticks, and will be fit to receive the *fire polish*. This *fire polish* is performed by putting one of the sticks through the notches in the furnace or stove, over a fire of charcoal, which must be previously made in it, where the wax must be continued and turned about till it be so melted on the surface that it become fluid as water, and run to a perfectly smooth shining surface; when being taken out of the heat, and suffered to cool it can be handled without affecting the polish, the other end must be put over the fire, and turned about in the same manner, till the whole be equally well polished. The difficulty in this operation lies in adjusting properly the heat of the plate or stone on which the wax is rolled, so as to keep it of a due consistence without softening or melting it to such a degree as to make it run or adhere to the plate or rolling-board, as also in regulating properly the fire in the furnace or stove for giving the fire polish. It is so difficult to fix a standard

for degrees of heat in these cases, that no positive rules can be laid down in points of this nature; but the conduct must be left in a great measure to the judgment of the operator, who may, nevertheless, soon find by trial how to accommodate these matters properly.

Hard sealing-wax may be formed into balls by putting a proper quantity on the plate or stone, and, having fashioned it into a round form, rolling it with the board till it be smooth.

The soft wax is easily formed into rolls, or cakes, by pouring the melted mass of the ingredients, as soon as they are duly prepared, into cold water, and then, while they are yet so soft with the heat as to admit of it, working them with the hands into any figure desired.

Sealing-wax, either hard or soft, may be scented by most of the perfuming ingredients used for other purposes, and the quantity, choice, and proportion to each other of the respective ingredients, are entirely arbitrary and dependent on taste or fancy. I will, however, give a recipe or two, to shew the manner of using each kind of ingredient, beginning with one of the most complex.

“ Take in proportion to a pound of the wax, of
 “ Benjamin half an ounce, of oil of Rhodium one scruple,
 “ of musk ten grains, and of civet and ambergrise, each
 “ five grains. Powder the Benjamin, musk, civet, and
 “ ambergrise together, and then rub the oil of Rhodi-
 “ um among them; and when the wax is ready to be
 “ wrought into sticks, sprinkle in the mixture, and stir
 “ it well about, that it may equally diffuse among the
 “ wax.”

The following is, however, a simpler composition, but will be found much more grateful to most persons, as there are many to whom the scent of musk and civet are very disagreeable.

“ Take of Benjamin one ounce, of oil of Rhodium
 “ one scruple and a half, and of ambergrise five grains.
 “ Treat them as the foregoing.”

In perfuming the soft wax, the Benjamin may be omitted, as it requires a considerable heat to produce its scent to any effectual degree; but that alteration being made, either of the preceding compositions may be

used; as in the case of the hard wax, and the ingredients may be added to the olive oil, before it be mixt with the bees wax and turpentine, or to the mass after it has boiled a due time; or, to prevent the dissipation of the scent which heat occasions, the perfuming mixture may be worked or kneaded into the wax by the hand, keeping it soft by holding it in a gentle warmth before the fire.

C 3

PART II.

Of Engraving, Etching, and Scraping Mezzotintos.

CHAP. I.

Of Engraving in general.

BY engraving is to be here understood only that kind which relates to printing. In this sense, it is the making, correspondently to some delineated figure or design, such concave lines on a smooth surface of copper or wood, either by cutting or corrosion, as render it capable, when charged properly with any coloured fluid, of imparting by compression an exact representation of the figure or design to any fit ground of paper or parchment.

The methods by which engraving is at this time performed is of three kinds; by the graver or tool alone, which is in common language the only kind called *engraving*; by corrosion with *aqua fortis*, which is generally called *etching*; and by covering the surface of a copperplate with lines, in such manner that the whole would produce the effect of black in an impression, and then scraping or burnishing away part of the lines, so as to cause the remainder to have the same effect as if they had been cut on the even surface, according to the delineation of any figure or design; which last kind is called *scraping in mezzotinto*.

Engraving with the tool was the kind originally practised, and it is yet retained for many purposes; for though the manœuvre of etching be more easy, and other advantages attend it, yet where great regularity

and exactness of the stroke, or lines are required, the working with the graver is much more effectual. On this account it is more suitable to the precision necessary in the execution of portraits, as there every thing the most minute must be made out and expressed, according to the original subject, without any license to the fancy of the designer in deviating from it, or varying the effect either by that masterly negligence and simplicity in some parts, or those bold sallies of the imagination and hand in others, which give spirit and force to history painting.

Etching is of a latter invention (though not very modern) than engraving with the tool, of which it was at first only an imitation that was practised by painters and other artists, who could much sooner form their hand to, and attain a facility of working in this way than with the graver; but being then, nevertheless, considered as a counterfeit kind of engraving, and therefore inferior to the other, it was cultivated in a very confined manner; the closeness of the resemblance of the work to that performed by the tool, being made the test of its merit; and consequently, the principal object of aim in those who pursued it. This servile confinement of the art of etching to the imitation of the original kind of engraving, was a great cause of retarding its advance towards perfection; as many of the most able masters cramped their talents with the observance of it, which may be seen in the instances of Sadeliers, Vilamene, Swanneberg, and particularly Le Bosse, who, in his treatise on engraving, has laid it down as a principle, that the perfection of this kind consists of the close similitude of the work with that done by the tool. This absurd prepossession has since been worn out; and the method of working with *aqua fortis* has been so far improved, that instead of being now deemed a spurious kind of engraving, it evidently appears the foundation of an excellence in many modern works, that could never have been produced without it. Since, though the neatness and uniformity of the hatches, which attend the use of the tool, is more advantageous with respect to portraits; yet the liberty and facility of the other manner gave a much greater opportunity to exercise the

force of genius and fancy in history painting, where the effect of the whole, and not the minute exactness in finishing all the parts, constitutes the principal value. There are two manners practised of engraving in this way, the one with *hard* varnish or ground, the other with a *soft*. The first was formerly much used, being better accommodated to the intention of imitating the engraving with the tool, as the firmness of the body of the varnish gave more opportunity of retouching the lines, or enlarging them with the oval pointed needles, called by the French *ecoppes*, as was practised by Le Bosse and the others for that purpose. The latter has now almost wholly superseded the use of the other, by the free and supple manner of working it admits of, which gives a power of expression incompatible with the greater inflexibility of the hard varnish, that confines the lines and hatches to such a regularity and sameness as gives a stiffness of manner and coldness of effect to the work.

The mixture of the use of the tool and *aqua fortis*, which are now both employed together in many cases, has however given that perfection to engraving which it bears at present. The truth and spirit of the outline that the method of working with *aqua fortis* affords, and the variety of shades which the different kinds of black producible in this way, as well as other means of expressing the peculiar appearance and character of particular subjects, furnish what was defective in the sole use of the tool; while, on the other hand, the exactness and regularity of the lines which are required for finishing many kinds of designs, are supplied by the graver; and by a judicious application of both, that complete finishing is obtained, which either of them alone must necessarily want.

The *scraping mezzotintos* is the last-invented manner of engraving, and may be justly esteemed a very valuable acquisition to the art. As the great softness of the effect, which may be had along with the strongest relief, fits it extremely to the purposes of portraiture, particularly in the case of women or younger men, and gives it much more the qualities of painting than either of the other kind, an effort has been made to apply this art to

a purpose of yet much greater consequence; which is, by printing with several colours to produce pictures not essentially different from those that are painted. The invention of this art is ascribed to Mr. Le Blond, the only person who has hitherto brought it into practice with success; but he advanced it so far as to shew, by the specimens he gave, that it was capable of being carried to great perfection, and of being the means of producing good pictures of eminent persons at a much less expence than by the method of painting.

Engraving, with a view to printing, is in general at present practised on copper or wood. In this part of the world, all designs subservient to more elegant works, are engraved on copper, and wood is only used for very coarse or simple purposes. But the Chinese, who intermix printing and painting much more than we do, seem to make a very advantageous use of the engraving on wood, in the execution of which they doubtless exceed what we have any conception of here, and produce very fine outline sketches, which greatly assist in the painting, even in very large pieces, by means of wooden prints. It were to be wished, therefore, that the engraving on wood was more encouraged and cultivated here; especially as paper hangings, to the manufacture of which it is greatly subservient, is becoming now a very considerable article of trade, and at present possessed by ourselves alone.

C H A P. II.

Of the choice and preparation of Copper-plates for Engraving.

PLATES intended for engraving, ought to be formed of the best copper, which can be distinguished only by examining it with regard to the qualities requisite to the constituting it good. These qualities are, that it should be very malleable, that is, capable of be-

ing spread with the hammer, or suffering itself to be rolled or drawn out to the nicest or smallest pieces; that it should nevertheless be firm, and resist even to some degree of hardness, provided no shortness of grain or brittleness attend, but that it be perfectly ductile; and that it be free from any veins, specks, or dissimilar parts, but of an equal texture through the whole. The redness of copper is a presumptive mark of its being good, but not an infallible one; for though it is, in general, a proof of the purity of the copper, yet it does not evince that the qualities may not be injured by too frequent fusions, or the calcinations it may have undergone, if, as is frequently the case, it has before been employed in forming some utensil.

The copper being chosen, it must be fabricated into plates of the size demanded, the thickness of which may be in the proportion of a line to plates that are a foot by nine inches. These plates must then be well forged, and planished by a brazier, which should be done cold; for by managing this operation well, the porosity of the copper may be greatly removed, which is for the most obvious reasons of great consequence. When a plate is forged, it should be examined which side is the most even, and the least flawed or cracked, and then the polishing may be thus performed.

Put the plate upon a board leaning obliquely, and in the bottom of which two nails, or points of nails, are fixed, to keep it from sliding off. Then take a large piece of grind-stone dipt in clean water, and rub it very strongly once in every part lengthways, and then the same breadthways, keeping it moist with water; and repeat this operation till no hollows appear, nor the least mark made by the hammer in forging, or any other flaws, holes, or inequalities. After this, take a piece of good pumice-stone, and rub the plate with it in the same manner as was done before with the grind-stone, till all the scratches and marks made by the grind-stone may, by the pumice-stone, be likewise taken away, and then wash it thoroughly clean. The scratches and marks of the pumice-stone should then be taken out by rubbing the plate in the same manner with a piece of oil-stone, till all the marks and scorings of the pumice-stone be

taken out; and the plate should be then again washed with water till it be perfectly clean. A proper kind of coal must in the mean time be prepared for finishing the preparation of the plate, which must be done in the following manner:

Take three or four large coals of fallow wood, sound and without clefts, and place them together in a fire made on a hearth, and cover them with other burning coals, heaping a quantity of red-hot ashes upon them. In this manner let them remain, being subject to only a small access of air, for about an hour and a half; but the time should be greater or less according to their size, that the fire may penetrate into the innermost part of them, and expel all the smoke that can be driven out; to be certain of which, it is better they should stay in the fire rather longer than is necessary, than that the time should be unduly shortened. When they are fit to be taken out, a vessel of water large enough to hold them should be prepared, and they should be instantly thrown into it, and left there to extinguish and cool. For this purpose some use urine instead of water; but there is no difference, unless in the disagreeable smell of the latter. The coals being thus prepared, pick out one, or a part of one, sufficiently large, firm, and free from clefts, and holding it fast in the hand, set one of the corners against the plate, and rub it, but without observing any particular manner, to take out the marks or scorings of the oil-stone. If nevertheless the coal glide on the surface, and take no effect, it is a proof of its not being fit for the purpose, and another, that is not so faulty, must be used instead of it. This fitness may be thus distinguished, that the coal, if good, being wet, and rubbed on the copper, will seem rough, and grate it with a low murmuring noise. When a good coal is obtained, the operation must be continued till not the least scoring, flaw, or hole whatever appear. But if the coal itself, as will sometimes happen, be too hard, and leaves traces or scores of its own forming, a softer one must be chosen, and used in the same manner as the first, to remedy the defects of it, and to procure a perfectly clear and even surface on the plate.

This is the method directed by Le Bosse. But the end may be better answered, by first wearing out the marks of the planishing hammer by rubbing with emery finely ground, and then, the plate being washed clean, brushing it over with the refiner's *aqua fortis*, as below directed to be prepared; which must be suffered to lie on till the ebullition it produces begins to decrease, and then washed off by immersing the plate in water; when it will be found to be brought to a better condition to take the burnish with more certainty, than by the laborious use of so many stones and the coal.

The plate being brought to this state, the polishing must be finished with a steel burnisher, with which it must be strongly rubbed. The best method of moving the burnisher is not to work it lengthways, or breadthways, but in a diagonal direction, or from corner to corner; which will more effectually take out all remains of the former scorings or lines. The copper must be thus burnished till it be as bright as looking-glass in every part; but if, when the rest is thus bright, some particular spots appear dull, or any lines remain, such faulty parts should be again worked with the burnisher, till the whole be uniformly shining.

When the plates are designed for etching, being thus finished with the burnisher, they should be well washed with clean water, and then dried by the fire. After which they should be wiped dry with a linen cloth; and to be certain that there may be no kind of grease upon them, they should be rubbed over with the crumb of very stale bread. And the scraping very soft chalk over it, and rubbing the plate well with it, is a very sure means of prevention of either any grease, bread, or other foulness whatever remaining. There is one very certain method of trying whether the plate be perfectly well polished, or not. This is, to rub it over with the printing ink, and proceed to take (or pull-off, as it is called) a proof in the same manner as if it had been engraved; which, if the plate makes not the least impression on the paper, but leaves it entirely white as before it passed through the press, shews the polishing is complete. But if, on the other hand, any lines appear to be printed, it is evident the plate is faulty, and

must be polished over again, either by the other means, or the burnisher, as the strength of the lines may indicate occasion. If, however, the plate be designed for etching, great care ought to be taken, after this method of trial, to cleanse it thoroughly from the oil of the printing ink, or any other foulness.

C H A P. III.

Of Engraving with the Tool or Graver.

SECT. I.

General Nature of Engraving with the Graver.

ENGRAVING with the tool or graver, which, as has been observed before, was the original kind, is performed by cutting lines or hatches on the polished surface of a copperplate, by instruments of steel adapted to that purpose.

It is much the most difficult manner of engraving that can be undertaken, requiring greater practice and command of hand, in order to succeed in any distinguished degree, than either etching, or scraping mezzotintos. Its superior fitness for many purposes will, nevertheless, always continue the use of it; and it is indeed absolutely necessary, that they, who pursue etching with a view to any subjects of consequence, should understand, and, in some measure, be executively masters of the management of the tool; for greater designs, finished wholly by *aqua fortis*, will want many beauties and advantages that may be obtained by the aid of this.

In engraving with the tool, there is a great difference observable in the manner even of those who have been held in esteem. Some appear to have a great facility the use of the graver, others to have a much more labo-

rious and stiff way ; which, with whatever merit of other kinds it may be attended, is yet a defect. But, on the other hand, some masters have seemed to place so much in this facility as to neglect outline, expression, and even the clair-obscur of the pictures after which they engraved. In what particulars this faulty or laborious stiffness consists, we shall have occasion to observe, when we examine the peculiar difference of the methods of engraving with the graver.

SECT. II.

Of the Apparatus, or set of Instruments necessary for Engraving with the Tool.

THE principal instruments used in engraving with the tool, are gravers, burnishers, an oil-stone, and a cushion for bearing the plates.

Gravers are made in several forms with respect to the points, some being round, others square, and a third kind lozenge. The round pointed is best for scoring lines, the square for cutting broad and deep, and the lozenge for more delicate and fine strokes and hatches. Le Bossé recommends, as the most generally useful, such as are of form betwixt the square and lozenge, and advises that they should be of a good length, small towards the point, but stronger upwards, that they may have strength enough to bear any stress there may be occasion to lay upon them. For if they be too small, and mounted high, they will bend, which frequently causes their breaking, especially if they be not employed for very small subjects. The gravers should be made of the best steel, which must be drawn out into small rods, with a charcoal fire. These rods should be cut into the lengths chosen for the graver, and these softened in their temper, by heating in a charcoal fire, and suffering them to cool very slowly, either by continuing them in the fire till it extinguishes, or taking part of the burning embers out of the fire, and burying the lengths of rods in them, till the whole grow cold. They should then be filed into the form desired, and afterwards brought back to a hard temper, by heating them red hot, and

while they are so, thrusting the end into a lump of soft soap. But, in doing this, great care should be taken to put them into the soap with a true perpendicular direction; for, if they be turned in the least obliquely, the graver will warp, and be crooked. If the temper of the graver be found too hard after this treatment, and prevent the whetting it properly to an edge, it may be softened by taking a large burning piece of charcoal, and laying the end of the graver on it till it begin to grow yellow, and then thrusting it into a lump of tallow, or dipping it in water; but, if water be used, the graver must not be too hot, or it will not be softened by this treatment. It may be distinguished whether the graver be tempered to a proper hardness or not by touching the edge of it with a file, which, if any effect follow from it, proves the temper too soft. The best proof of too great hardness is the breaking of the point in the engraving: after which, nevertheless, if a new edge be made by whetting the graver, it will be frequently found very good without any other alteration. The graver being thus formed, must be mounted in a proper handle, the size of which should be adapted to that of the hand of the person who is to use it, and then the graver must be whetted on the oil-stone till it have a due edge. The oil-stone, though a very necessary implement in engraving, is too well known to require any description here; I will therefore proceed to shew how the gravers must be finished by being whetted on it. The stone must first have a few drops of olive oil put on it. Then one of those sides of the graver which form the angle that is to give the edge for cutting the plate should be laid flat upon it, and being pressed firmly down by the fore-finger extended upon it, it must be rubbed by pushing it forwards, and drawing it back till the side be very flat and even. This treatment must be likewise repeated with regard to the next side, till a very sharp edge be formed for about an inch of the length of the graver. When the graver is intended to have a lozenge point, it must be set obliquely on the stone, with the edge which is already formed uppermost; and in this position it must be whetted till the end applied to the stone be flat, notwithstanding the obli-

quity of the position, and produce a slope with respect to the other sides, so as to form a lozenge. If the face of the graver be too large, it may be remedied by taking off a little from the two sides which do not form the edge. Care should be taken that the sides of the graver be whetted very flat, with the edge rising a little towards the extremity of the point, in order that it may the more easily be disengaged from the copper, and also that the point be sharp, if the work be desired to be fair and lively, for a blunt graver can do nothing but scratch; and to take off the roughness left by the oil stone, it is practised to strike the point of the graver into a piece of box or any hard wood, which will answer that end. The sharpness of the point of a graver can scarcely be distinguished by the eye, and it is therefore usual to try it on the nail, where it will be easily perceived whether it cuts keenly or not. After the graver is mounted with a proper handle, and whetted, it is necessary to cut off that part of the knob of the handle which is in a line with the edge of the graver, in order to render the whole of it so flat on that side, that it may be applied in any direction to the plate.

Burnishers are another kind of instruments used to assist in the engraving on some occasions as well as to polish the plates. Those used for engraving may be such as are made for other purposes, which, being to be procured every where, do not require a further description here. The principal application of them in engraving, besides their use in polishing the plates, is to take out any scratches, or accidental defacings, that may happen to the plates during the engraving, or to lessen the effect of any parts that may be too strongly marked in the work, and require to be taken down.

A cushion, as it is called, is likewise generally used for supporting the plate in such manner that it may be turned every way with ease. It is a bag of leather filled with sand, which should be of the size that will best suit the plates it is intended to bear. They are most commonly made nine inches squares, and three or four in thickness.

SECT. III.

Of Holding and Handling the Graver.

THE graver being prepared, and the part of the handle next the steel properly cut, it must be held in the hand, so that on applying it to the plate the edge may be towards it. The manner of holding it is to let the handle be in the hollow or palm of the hand, with three fingers compressing it to one side, and the thumb on the other, and the fore-finger extended upon it towards the point opposite to the edge, so that the graver, being applied flatly to the plate, may be guided by the motion of the hands, and the point pressed with greater or lesser force, as may be required, by the fore-finger which bears upon it, in such manner that lines may be cut which will be smaller at the extremities, and deeper in the middle; but care must be taken that the fingers do not embrace the handle in such manner as to interfere and hinder the graver from being carried level on the plate, which would cause the lines to be rugged, unequal in different places, and deeper than they ought to be. It is necessary, likewise, that the graver be firm in the hollow of the hand, the knob of the handle bearing against the part of the hand which forms the point with the arm, that a greater force may be exerted against the resistance of the copper, particularly in making large and deep hatches.

SECT. IV.

Of the general manner of managing the Graver.

THE cushion, made as above directed, being laid on the table firmly fixt, the plate must be put upon it, and the graver being held in the hand, according to the instructions before given, the point must be applied to the plate, and moved in the proper direction for producing the figures of the lines intended. It must be

observed, in forming straight lines, to hold the plate steady on the cushion, and, where they are to be finer, to press more lightly, using greater force where they are to be broader and deeper. In making circular and other curve lines, the hand and graver must be held steady, with the arm resting upon the table, and the plate moved upon the cushion under the graver, so that as each proper part passes the point, the figure intended may be cut upon it; for crooked and winding lines cannot be produced with the same neatness and command by any other means. After part of the work is engraved, it is necessary to scrape it with the sharp edge of a burnisher or engraver, passed in the most level direction over the plate, to take off the roughness formed by the cutting of the graver; but great care must be taken not to incline the edge of the burnisher, or tool used, in such a manner that it may take the least hold of the copper, as it would otherwise produce false strokes or scratches in the engraving; and, that the engraved work may be rendered more visible, it may afterwards be rubbed over with a roll of felt dipped in oil. In using the engraver, it is necessary to carry it as level as possible with the surface of the plate; for otherwise, if the fingers slip betwixt them, the line that will be produced, whether curve or straight, will become deeper and deeper in the progress of its formation, which entirely prevents strokes being made at one cut, that will be fine at their extremities, and larger in the middle, and occasions the necessity of retouching to bring them to that state; for this reason, it is very necessary for those who would learn to engrave in perfection, to endeavour, by frequent trials, to acquire the habit of making such strokes both straight and curving, by lightening or sinking the graver with the hand, according to the occasion. If after finishing the design, any scratches appear, or any part of the engraving be falsely executed, such scratches or faulty parts must be taken out by the burnisher, and further polished, if necessary, by a roll of felt and oil. The plate may be cleansed again, as at first, by crumb of bread and chalk, in order that the obliterated parts may be restored, where there is occasion, by re-engraving it.

The plate being thus engraved, it is proper to take off the edges, by using first a rough file, and afterwards a smoother, and to blunt the corners a little by the same means; after which, the burnisher should be passed over the filed places to take away the scorings, that no part of the printing ink may be retained in them.

SECT. V.

Of the particular manners of Engraving.

THERE are some who shew a facility in engraving, or others that have a laborious manner, and some also affect to cross their strokes very much in the lozenge manner, while others make them entirely square. The free and easy manners here meant, are those of Goltzius, Muller, Lucas, Kilian, Melian, and some others. They seem, on many occasions, to apply themselves only to shew, by the turning of the strokes, that they were masters of the graver, without giving themselves any trouble about the justness of the outline, expression, or even the effect of the clair-obscur which was found in the drawings or pictures after which they engraved.

The manner which I deem laborious is, where there are an infinite number of lines and points, or dots, confounded with each other, and disposed without order, which have the resemblance rather of a drawing, than the appearance of an engraving.

The strokes should never be crossed too much in a lozenge manner, particularly in flesh; because such crossings form sharp angles, which give the disagreeable effect of lattice-work, and takes away from the eye the repose which is agreeable to it in all kinds of picturesque designs. The strokes ought not to be so much crossed in this manner, except in the case of clouds, tempests, representations of the waves of the sea, and the skins of hairy animals, or of the leaves of trees, where it may be very well allowed of.

The manner betwixt the square and lozenge is much more useful and agreeable to the eye, but it is more

difficult to pursue, as the inequality of the strokes shews itself more. But in avoiding the lozenge, it is not however proper to go entirely into the square, for that gives too much of the hardness of stone.

In the manner of guiding the strokes, the action of the figures, and of all their parts, ought first to be considered. It should be next observed, how the parts come forwards to, or go back from the eye. The graver should then be guided according to the risings or hollows of the muscles and folds, spreading the strokes more asunder under the lights; bringing them closer together in the shades, and also at the extremity of the outlines, to which the strokes of the graver must be carried, that they may not appear jagged; and lightening the hand in such manner that the outlines may be formed and terminated without being cut or hard. Examples of this may be found in the works of the famous Edclinck, who greatly possessed this talent.

Although strokes are broken off at the place of the muscles, whether it be to form them, or to produce the effect more commodiously, there should, nevertheless, be always preserved a certain connection or link of one with the other, that the first stroke may frequently serve, by its return, for the second. This displays a freedom; and the engraving that is so managed is more beautiful, in proportion as it appears to be done with more facility.

The strokes should, however, be always made to run as naturally as possible, avoiding wild turnings, which are more the effect of caprice than reason. At the same time care must be taken not to fall into a straight direction, which many do when they strive to engrave neatly; because it is more easy for them to push forward the strokes of the graver, that are but little turned, than to guide them according to the risings and hollows of the muscles, which they do not understand, from their want of sufficient knowledge in design.

In engraving the hair and the beard, the principal grounds should be first laid, and then the chief shades should be sketched, leaving the strong lights, that, if it be desired, in the finishing them they may be covered to the extremity. This kind of sketching should be done

as it were, in a careless manner; that is to say, with few strokes, and those even unequal with respect to each other, to have room in the finishing to mix smaller strokes in the vacancies, which this inequality will produce. This manner seems much less hard than where every hair is distinguished, and as much effect as possible ought to be made by every stroke, especially when the figures are not very large. For this reason none ought to be introduced but such as have the necessary force; and if some second strokes are, however, run at the side of the shades, to mix and give them more union with the flesh, they should be very small.

When the sculpture is to be represented, the work ought never to be made very black; because, as edifices are commonly built either of stone or white marble, the colour, being reflected on all sides, does not produce browns, as in other substances. White points must not be put in the pupils of the eyes of figures, as in engraving after paintings, nor must the hair or beard be represented as in nature, which makes the locks appear blowing in the air. This would be to do things contrary to truth; because in sculpture there can be no such appearances.

In engraving cloths of different kinds, it ought to be observed, that linen should be done with smaller and closer lines than other sorts. It must be all executed with single strokes; or, if there be two admitted, it should be in some small spots only; and these should be only in the shades, to give an union and hinder a rawness which might result from the opposition, when it was either upon, or close to, other draperies, or any brown bodies, crossed with many strokes.

When white woollen cloth is in question, it ought to be engraved wide accordingly, as the stuff may be coarse or fine, but with two strokes only. It may be objected, that instances may be found where there are three; but the answer is, that it has been done only for despatch. If the difference in stuffs can be made to appear, it renders the work more agreeable; but the trouble in doing it is very great, and the labour greatly multiplied.

There remains only to remark, with regard to the engraving cloths, that on all occasions when there arises

a necessity of crossing the strokes, the second should be smaller than the first, and the third than the second, as the work will have much more softness for it.

Shining stuffs ought to be engraved more hard, and more straight than others; because, as they generally are of silk, they produce folds that are flat and broken; particularly if they be satin, which is stiff on account of its gumminess. These stuffs should be expressed with one or two strokes, according as their colours are bright or brown. Betwixt the first strokes others smaller must be joined, which are called *entre-deux*. Velvet and plush are expressed in the same manner, with the *entre-deux*. The only difference should be, that the first strokes ought to be much larger and fuller than those of other stuffs, and the second should be smaller, but still retaining the fulness of the first.

Metals, as vases of gold, or of copper, or armour of polished steel, should be likewise treated in the same manner with the *entre-deux*; and that which produces the shining appearance, is the opposition of the browns with the lights.

With relation to architecture, perspective informs us that the strokes which form the rounding objects must tend to the point of sight.

When whole columns occur, it is proper to make out the effect as much as possible by perpendicular strokes, because that in crossing them, according to the roundness, the strokes which are near the capitals being opposed to those which are in the place of the base, make a disagreeable effect at the height of the eye; at least if so great a distance be not supposed as renders the objects almost parallel.

In the case of landscape, those who are versed in the use of *aqua fortis* may make the outlines with it, particularly of the leaves of trees. This is a little more expeditious, and will answer the purpose very well, provided discretion be used in not doing it too strongly, and that in finishing with the graver, the work of the *aqua fortis* may not remain distinguishable, nor any way take off from the softness.

To do it well, it is proper to conform to the manner of Auguine Carrache, who did it admirably by touches;

at a higher finishing may be made according to the occasion. Villamene and John Sadeliers, have also succeeded very well in touching; as likewise Cornelius Gort; who has engraved many things after Merian very nicely, and who, indeed, may be taken as a sufficient guide.

In engraving mountains, the strokes ought to be frequently discontinued, and broken, for sharp and scraggy objects, and they should be straight, in the lozenge manner, and accompanied with some long points or dots. Where rocks are in question, the strokes should be crossed with others more square and evenly, because the ground is generally more polished.

The distant objects, which are towards the horizon, should be kept very tender, and be but slightly charged with black, although the mass appears brown; as it may happen to some shades, supposed to be caused by accidents of clouds that intercept the light of the sun. Because these shades and lights, however strong they may appear, are always weak in comparison of those of the figures, or other objects, which are found on the fore-ground of the picture, from the great distance, and the air that is interposed before these objects.

In the representation of waters the state of them is to be considered; some being calm and still, and others turbulent and agitated; as the sea by the winds, and cascades by the fall. With respect to calms, they are best represented by strokes that are straight and parallel to the horizon, with *entre-deux* that are smaller, omitting such places, as, in consequence of gleams of light, make the shining appearance of water. The form of objects reflected, or advanced near in distance upon the water, upon the banks of it, are expressed by the same strokes, re-touched more strongly or faintly as occasion may require it; and even by some that are perpendicular, and such reflected objects are more or less distinctly made out accordingly, as they are found nearer, or more distant from, the fore-ground of the picture. If they be trees, they ought to be marked out by an outline, particularly if the water be clear, and upon the fore-ground of the picture, because the representation

which the water makes of them is as distinct as the trees themselves.

For water agitated, as in the waves of the sea, the first strokes ought to follow the figure of the waves, and the cross strokes ought to be very much lozenge. If water fall down any rock with rapidity, the strokes should follow the fall, being mixt with *entre-deux*, and the shining spots which are found in the places, where the light strikes perpendicularly, should be very vivid, particularly if it be on the fore-ground.

In engraving clouds, play should be given; the graver should sport, when they appear thick and agitated, in turning every way according to their form and their agitation. If the clouds produce shades, which render it necessary to put two strokes, they ought to be crossed more lozenge than the figures, because that gives a certain transparency that is very suitable to those bodies which are composed only of vapours; but the second strokes should be predominant over the first.

The flat clouds, that lose themselves insensibly in the clear sky, should be made by strokes parallel to the horizon, a little waving conformably to the thickness which may appear. If seconds be required, they should be more or less lozenge; and when they are brought to the extremity, the hand should be so lightened that they may form no outline. The flat and clear sky is represented by parallel strokes; but very straight, without the least turning.

SECT. VI.

Of Engraving in Great.

FOR great works, that is, when the figures are of considerable size, they ought to be engraved wide; the strokes should be steady and full large, and continued as far as they can; that is to say, they should not be broken off, till they come to the places of the muscles or folds which absolutely require it. The same, indeed, ought to be done in the case of small works, to shew that the execution was in an easy manner, and without

mu
can
shac
be
to
mor
ness
T
the
with
be l
be fi
kept
black
is e
supp
ness.
ough
shade
there
case
more
colour
It
imitat
ing b
imitat
ence
low,
imitat
others
grave
shall b
the pri
more p
it is w
should
meets
light a
daced b
what is
be avoi
Vol

much labour. If the strokes are to be retouched, which cannot be avoided in many places, especially in the shades, where the force and union of the picture are to be well preserved, it should be done the contrary way to that in which it was sketched, and with a graver more lozange. This adds much to the life and neatness of the work.

There ought not to be too much work made upon the lights; but they should be gone over slightly, and with few strokes; or, in other words, the lights should be loosely touched, and only in demi-teints. If they be finished to the highest degree, they should be still kept very clear; for if, on the contrary, they be too black, it diminishes and prevents the effect, because it is extremely difficult to find browns in the shades to support them, so as to give a sufficient force and roundness. If the work be after original drawings, they ought to be first engraved with great lights and great shades; because, let them be never so much finished, there cannot be so many particulars to express as in the case of painted pictures, which require likewise much more care and labour on the score of their different colours.

It may be objected, perhaps, that it is impossible to imitate colours, as there is no medium for it in engraving but black and white. When, however, I speak of imitating them, I do not intend to express the difference betwixt green and blue, nor betwixt red and yellow, nor of any of the rest in particular, but only to imitate the masses; and Wovermans, Bolswert, and some others, have done this with success, when they have engraved after Rubens. Works, in which this matter shall be executed by an able engraver, who is master of the principles of his art, will, undoubtedly, be much more pleasing, and have a much finer effect, than where it is wanting. It is proper, therefore, the engraver should be intelligent and skilful, because he sometimes meets with colours that are light, on others which are light also, where, consequently, no effect can be produced but by the difference of the hue. This makes what is called a *corps perce*, an accident very carefully to be avoided, because it takes away all means of judging

of the clair-obscur. It is necessary, likewise, to take care not to destroy the principal lights, by affecting to imitate colours too much, particularly in the case of figures on the fore-ground, for that hinders their coming forwards, and breaks in entirely on the intention of the painter.

SECT. VII.

General Maxims of Engraving with the Graver.

TO preserve the equality and union in engraved works they should be sketched into great parts before the finishing of them be undertaken; for example, of one, two, or three figures, if the subject be history, and these figures be grouped: after this sketch is made, the design should be so far completed, that every thing may be perfectly made out, except with respect to the force, in the same manner as if it was intended to remain in that condition; because, whoever waits to make the design in finishing, will very often find themselves deceived. This will even happen to such a degree that there will be no remedy without effacing part of the work, which many persons will not be willing to consent to, for fear of spoiling that neatness of the graver they have shewn, and on which they have bestowed all their care, believing all the art of an engraver to consist in such neatness; whence we have so many prints where the copper is well cut, but where, at the same time, none of the talents of an artist are displayed.

If any infer, from what is here said, that it is useless to engrave well, they fall into another error; for it is necessary to possess that talent, in order to join, with the justness and correctness of design, the beauty of the work; though not to give them up entirely for this, and to place the capital merit in those lickings, over, which often render the work black, foul, and spiritless.

It is not meant, nevertheless, that the work should be made grey; on the contrary, it is much better that it should have strength. But the force of a print does not

ET b
instead
The
formed
proper

consist so much in blackness, as in the degradation of the lights to browns, which ought to be made in a more or less lively manner, according to the distance or nearness of the objects to the eye; and even if the works of the great masters be examined, it will be found that they are not black, or at least have only become so with time. They have effectually imitated nature, who is not so, especially in the flesh, and therefore have avoided this, unless when they have represented some night scene, illuminated only by the light of a candle or lamp.

Works in small, demand to be engraved with narrower strokes than larger, and with gravers formed a little in the lozenge manner; but the strokes should not, however, be too dry and lean, though the figures be small. If the piece require to be extremely high finished, it should not, nevertheless, appear overloaded and murdered with work; but, on the contrary, it should be touched with art, in such manner that it may seem to be done with expedition and ease, although laboured, in reality, with the utmost attention.

CHAP. IV.

Of Etching or Engraving with *aqua fortis*.

SECT. I.

General Nature of Etching.

ETCHING (as was mentioned before) is engraving by corrosion, produced by the means of *aqua fortis*, instead of cutting with a graver or tool.

The manner (in a general view) by which this is performed, is the covering the surface of the plate with a proper varnish or ground, as it is called, which is ca-

pable of resisting *aqua fortis*, and then scoring or scratching away, by instruments resembling needles, the parts of this varnish or ground, in the places where the strokes or hatches of the engraving are intended to be. Then, the plate being covered with *aqua fortis*, the parts that are laid naked and exposed by removing the ground or varnish, are corroded or eaten away by it, while the rest, being secured and defended, remain untouched.

There are two methods of etching (as was intimated above) the difference of which from each other consists as well in the difference of the varnish or ground, as in that of the *aqua fortis* adapted to each kind; but the general method of performing them is alike in both. These varnishes, or grounds, are distinguished by the names of *hard* and *soft*; for in their consistence, or the resistance they give to the needles, lies their essential variation from each other. The hard varnish (as I have good reasons to conjecture) was not the first in use, but soon took place of the other, and was, for some time, the most received in practice, on the account above mentioned, of its admitting the work to be made more like that of the graver. The soft has, however, since in its turn, prevailed to the exclusion of the hard, in some degree, except in the case of particular subjects; but not so entirely, nevertheless, as to take away the experience of shewing how it is performed. The method of etching with the soft varnish, is now, however, one of the most important objects of the art of engraving, as it is at present in universal use, sometimes alone, but more frequently intermixt with the work of the tool, and, in some cases, with great advantage, even where the whole is intended to pass for being performed by the graver.

S E C T. II.

Of the Instruments employed in Etching.

THE instruments employed in etching are needles, stifts, oil-stones, burnishers, scrapers, brush, pencils, and a frame and trough.

The needles used for etching are of the same kind with those used for common purposes ; but such should be chosen, of various sizes, as will bend without breaking, and are of the best steel, which must be distinguished by the grain. They should be mounted on sticks, the wood of which is firm and tough, so as to bear their being driven into it without splitting. The length of the sticks may be about six inches, and the thickness about three times that of a goose-quill, or more. The needles should be fixed in these sticks, in such manner that somewhat more than half an inch may bare, and the rest buried in the sticks, and they may be put at both ends ; or, in the place of one, a pencil may be fixed. There are two kinds of these needles used, the one called by the French *pointes*, and the other *echoppes* ; but with us they are distinguished only by the names of round pointed and oval pointed. By which latter it is to be understood, such as have one side of the round taken off to the middle of the point or centre. Though common needles may be, and most frequently are, used for this purpose, yet it is better to have small rods made by the smiths, in the manner above directed for the gravers, and to convert them into needles, at least this becomes unavoidably necessary where larger subjects are to be engraved. All the kinds are sold ready made at some ironmongers, with turned handles mounted with long knobs of copper filled with hard wax, into which the needles are stuck while it is hot, in order that, when by wearing they are become short, the wax being again heated, they may be lengthened at pleasure by drawing them further out. They should be chosen of three or four sizes, gradually increasing to that of those designed for the oval pointed, which should be the biggest.

Having a proper quantity of needles of different sizes thus mounted, the smaller orders of those designed to be round pointed must be whetted on the oil-stone, in such way as if intended for sewing ; but the larger of this kind must be rounder towards the point ; that is, with a less gradual slope from the body of the needle. It is proper also to whet some with a flat point, or in the manner of a chisel ; though it is best, nevertheless, in whetting all the kinds, to give them a long point

alike at first, and to make them rounder, or give the other proper form, by whetting away the redundant parts afterwards; for they may be easily made longer or shorter, according to the obliquity by which the handle is held in whetting them. By this way they will all take a little upon the copper, and will not hinder, by their largeness, the place where they are put from being seen in the using them, which is of the greatest consequence, especially in working in small. As it is difficult to make a point perfectly round, a method has been invented to render it more easy, by forming, in the bottom of the whetstone, a small channel, in which the needles are to be worked backwards and forwards, turning the handle in the fingers at the same time. But by whatever method the whetting may be performed, it is always necessary to have the slope forming the point, whether it be made upon a greater or less angle, exactly even on every side, that the point may pass easily and freely on the copper or varnish in whatever direction it may be guided. In forming the oval-pointed needles there is nothing more required than, after having given a blunt round point to them, to hold the handle with a proper degree of obliquity, and to work the needle on the whetstone till one side be worn down to the centre, observing to keep steadily the same part towards the stone; which, when some flatness is gained, will not be very difficult.

There is another kind of needle necessary, which is called a sift, and is used for calking and overtracing the design on the varnish. It must be formed of one of the smallest round-pointed needles, by blunting and polishing the point, that it may glide freely every way over the paper, without scratching or cutting it.

The scrapers and burnishers may be the same as were directed before.

The oil-stones are too commonly known to need any description. It is only necessary to observe, with regard to them, that they ought to be so soft as not to take too fast on the needles, but to give a keen smooth edge, which will not be the case if the stone be coarse and wear the needles too fast, besides the inconvenience

of producing beards at the points, which are extremely prejudicial in engraving on the varnish.

A brush pencil is likewise necessary for cleaning the surface of the varnish after the graving, and for other purposes. But there is nothing peculiar required in the form, and therefore such as are every where to be had may be used.

A frame of boards must be provided for supporting the plate, while the *aqua fortis* is poured over it, and a trough for receiving the *aqua fortis* as it runs from the board or frame on which it is put; as also an earthen pan to collect it as it falls from the trough. The board or frame should be considerably bigger than the plates it is intended to bear, and have a ledge or rising on it at the upper end, and two sides, as also two wooden pegs fixt near the bottom, to support the plate in its proper place, when the board is in an oblique position. The trough should be longer than the board, and about four inches deep, and six wide, with a sinking in the middle of the bottom, and a hole through the whole substance, that it may discharge the *aqua fortis* as quickly as possible. This board and trough should both be well covered with pitch, or, what is more convenient, painted over with several strong coats of fat oil and red ochre. There is no particular form necessary for the earthen pot; it is sufficient that it be capable of receiving and containing the *aqua fortis* as it runs through the hole in the trough. A vessel of the green glass, fashioned like a mortar, is better, however, for this purpose, where the refiners, or strong *aqua fortis*, is used, than any vessel of earth; and it is convenient to have another of the same nature for containing the *aqua fortis*, when it is to be poured on the plate, with a cylindrical glass, like those used for drinking, with a long handle for pouring on the *aqua fortis*. The use of this board and trough is principally for the hard varnish, where the *aqua fortis* is of a much weaker kind. For, in the case of the soft varnish, the glass vessel, without the trough, may be made to answer the purpose better, by the method we shall have occasion to explain below.

S E C T. III.

Of the Composition and Preparation of the Soft Varnish.

PREPARATION OF THE SOFT VARNISH, ACCORDING
TO LE BOSSE.

“TAKE of virgin’s wax very white and clean, and
“ of grains of mastic very clear and pure, each
“ one ounce, and of calcined asphaltum half an ounce:
“ grind the mastic and asphaltum separately, very small,
“ and melt the wax over the fire in an earthen pot well
“ glazed. When the wax is thoroughly melted, and
“ very hot, sprinkle into it the mastic gradually, that
“ it may melt also, stirring the mixture from time to
“ time with a little stick, in order that the ingredients
“ may be duly incorporated. Afterwards sprinkle the
“ asphaltum into the mixture, as was before done by
“ the mastic into the wax, stirring the whole composition
“ well together, over the fire, till the asphaltum
“ be entirely melted and commixt with the other ingredients,
“ for which about half a quarter of an hour
“ may be allowed: then take the pot from off the fire,
“ and let the mixture cool; and having put some clean
“ water in a plate, pour the varnish into it, and kneading
“ it well in this water, with the hands, form it into
“ a roll of about an inch diameter, or into little balls,
“ which may be lapt up in taffety, to be used in the
“ manner below directed.”

In winter it is proper to increase the quantity of wax, otherwise the varnish will be too dry, the proportion above given being calculated for summer.

PREPARATION OF THE WHITE VARNISH OF RHEN-
BRANT, TO BE LAID OVER A THIN COAT OF ANY
OF THE OTHER KINDS.

“ Take of virgin’s wax one ounce, of mastic half an
“ ounce, of calcined asphaltum, or of amber, half an
“ ounce: pound the mastic and asphaltum separately in

“ a mortar ; and, having a new earthen-ware pot well
 “ glazed, put the wax into it, and place it over a fire
 “ till the wax be melted ; then sprinkle in, by little and
 “ little, the mastic and asphaltum, and stir the mixture
 “ well together, till the whole be incorporated. Pour
 “ the melted matter afterwards into clean water, and
 “ form it into a ball, which must be kept for use.”

In using this varnish it is proper to take particular care of three things : The first, not to heat the plate too much when the varnish is put upon it ; the second, to lay the first coat of varnish as thin as possible, in order to be able to spread the white varnish upon it, without rendering the whole of too great a thickness ; the third, to omit blackening this varnish with smoke, as is done with the common ; but when it is become entirely cold, take a piece of white lead, and having ground it extremely fine, temper it with gum water, and then with a pencil lay a coat of it very thinly and equally over the whole plate. This is the manner in which Rhenbrant varnished his plates.

PREPARATION OF A SOFT VARNISH TAKEN FROM A
 MANUSCRIPT OF CALLOT.

“ Take of virgin’s wax four ounces, of amber, (or
 “ of the best asphaltum calcined) and of mastic, two
 “ ounces, of resin, of common pitch or shoemaker’s
 “ wax, each one ounce, and of varnish, or turpentine,
 “ half an ounce. Having prepared all these ingredi-
 “ ents, take a new earthen pot, and put it over the
 “ fire, with the virgin’s wax in it ; and when that is
 “ melted, add gradually to it the pitch, and afterwards
 “ the powders, stirring the mixture each time in pro-
 “ portion to the addition made to it. When the
 “ whole is sufficiently melted and mixed together,
 “ take the pot from the fire, and having poured the
 “ mass into an earthen vessel full of clean water,
 “ form it into balls, by working it with the hands, and
 “ keep them in a box, free from dust, for use.”

The two ounces of mastic is to be used only in summer, because it hardens the varnish, and preserves it from being crackt by the engraver’s leaning over the

plate during the graving; but in that designed for winter, only one ounce should be put.

ANOTHER PREPARATION OF THE SOFT VARNISH,
INSERTED IN SALMON'S POLYGRAPHICS.

"Take of virgin's wax four ounces, of asphaltum
"two ounces, of amber and mastic, each one ounce."

The preparation is much the same as for that preceding, only caution should be used that the fire be not too strong, as the varnish will otherwise be apt to burn. This varnish is good only for summer use, and would be too hard for winter.

PREPARATION OF AN EXCELLENT SOFT VARNISH,
OF WHICH MANY OF THE ENGRAVERS AT PARIS
MAKE USE AT PRESENT.

"Take of virgin's wax, and of asphaltum, or Greek
"pitch, each one ounce; of black pitch half an ounce,
"and of Burgundy pitch a quarter of an ounce. The
"The asphaltum must be pounded in a mortar, and
"the wax melted over a slow fire, in a pot of glazed
"earthen ware; and the rest of the ingredients added
"little by little, stirring the mixture accordingly, till
"the whole be well melted and incorporated, and tak-
"ing care that the matter be not suffered to burn.
"Afterwards, throw the whole mass into an earthen
"vessel full of clean water, and knead it with the
"hands, to form it into little balls; and then roll them
"up in new strong taffety, to be used as will be below
"directed."

PREPARATION OF A SOFT VARNISH ACCORDING
TO M. T.

"Take of virgin's wax two ounces and a half, of
"Burgundy pitch three ounces, of resin half an ounce,
"of asphaltum two ounces, and of turpentine one pen-
"nyworth."

This varnish is very good, and well approved. The preparation is the same as that of those already given.

PREPARATION OF ANOTHER SOFT VARNISH.

“ Take of virgin’s wax and asphaltum calcined two
 “ ounces, and of black pitch and Burgundy pitch each
 “ half an ounce. For summer half an ounce of white
 “ or brown resin may be added; but in winter there is
 “ no occasion for any. The wax and pitch must be
 “ melted in an earthen pot well glazed, and afterwards
 “ the asphaltum, pounded, must be added gradually;
 “ continually stirring the mixture till the whole be well
 “ incorporated together. The mass must be then cast
 “ into clean warm water, and kneaded with the hands,
 “ to mix it the better; care being taken that the hands
 “ be not sweaty, for that would spoil the varnish.

“ It is proper to observe, that the Burgundy pitch
 “ be very clean, and to be very brisk in stirring the
 “ ingredients when the asphaltum is put to them. After
 “ the ingredients have continued melted on the fire,
 “ for a quarter of an hour, the white resin must be put
 “ in, and stirred, as the other, with a stick. To exa-
 “ mine if the varnish be enough boiled, the stick must
 “ be drawn out, and observation must be made whether
 “ it rope or not: then it should be suffered to cool a
 “ little, and afterwards thrown into warm water, that
 “ it may be worked into balls by the hand, as has been
 “ before directed.”

PREPARATION OF THE SOFT VARNISH, ACCORDING
 TO MR. LAURENCE, AN EMINENT ENGLISH EN-
 GRAVER AT PARIS.

“ Take of virgin’s wax and asphaltum each two
 “ ounces, of black pitch and Burgundy pitch each half
 “ an ounce: Melt the wax and pitch in a new earthen
 “ ware glazed pot, and add to them, by degrees, the
 “ asphaltum finely powdered. Let the whole boil till
 “ such time as that, taking a drop upon a plate, it will
 “ break when it is cold, on bending it double three or
 “ four times betwixt the fingers. The varnish being
 “ then enough boiled, must be taken off the fire, and
 “ having been suffered to cool a little, must be poured
 “ into warm water, that it may work the more easily

“ with the hands, so as to be formed into balls, which
 “ must be lapt up in taffety for use.”

It must be observed, first, that the fire be not too violent, for fear of burning the ingredients; a slight simmering will be sufficient; 2dly, that while the asphaltum is putting in, and even after it is mixt with them, the ingredients should be stirred continually with a spatula; and, 3dly, that the water, into which this composition is thrown, should be nearly of the same degree of warmth with it, to prevent a kind of cracking that happens when the water is too cold.

The varnish ought always to be harder in summer than in winter, and it will become so, if it be suffered to boil longer, or if a greater proportion of the asphaltum or brown resin be used. The experiment above-mentioned, of the drop suffered to cool, will determine the degree of hardness or softness, that may be suitable to the season when it is to be used.

S E C T. IV.

Of the Composition and Preparation of the Hard Varnish.

PREPARATION OF THE HARD VARNISH, ACCORDING TO LE BOSSE.

“ TAKE of Greek pitch, or, in default of it, Bur-
 “ gundy pitch, and of resin, or colphony of Tyre,
 “ or, in default of it, common resin, each two ounces.
 “ Melt them together, upon a moderate fire, in a new
 “ earthen pot well glazed; and, these ingredients being
 “ thoroughly mixt, put to them eight ounces of good
 “ nut, or linseed oil, and incorporate the whole well
 “ together, over the fire, for a full half hour. Conti-
 “ nue afterwards to boil the mixture till such time as,
 “ having taken a little of it out, and suffered it to cool,
 “ it rope in touching it with the finger, like a very
 “ thick syrup. Take the pot then from the fire, and
 “ the varnish being a little cooled, pass it through a
 “ new linen cloth into some vessel of stone-ware, or of
 “ earthen-ware well varnished; and afterwards stop it
 “ up in a bottle, or any other vessel that will not soak

"it up, and can be well corked. Varnish made in this manner may be kept for twenty years, and will indeed be the better for age."

Mr. Le Bosse observes that Callot sent for his varnish ready made from Italy, and that it was prepared there by some joiners, who made use of it for varnishing their wood, under the name of *Vernice grosso da Liguaioly*, and that he gave him some of it, which he used a long time; but that when he wrote he employed the kind above described. The best is made at Venice and Florence, where it is sold by the grocers and druggists.

The varnish, of which the preparation is above taken from Mr. Le Bosse, is subject to many inconveniences; that of Callot, just mentioned, is much better, and more easy to be used. The manner in which it is made at Florence is as follows.

PREPARATION OF THE HARD VARNISH USED BY
CALLOT, COMMONLY CALLED THE FLORENCE
VARNISH.

"Take four ounces of fat oil very clear, and made of good linseed oil, like that used by painters. Heat it in a new pot of glazed earthen ware, and afterwards put to it four ounces of grains of mastic well powdered, and stir the mixture briskly till the whole be well melted together. Then pass the whole mass through a piece of fine linen, into a glass bottle, with a long neck, that can be stopp'd very securely, and keep it for the use that will be below explained."

S E C T. V.

*Method of applying the Soft Varnish to the Plate, and of
Blackening it.*

THE plate being well polished and burnished, according to the directions given p. 55, as also cleansed from all greasiness by chalk or Spanish white, put it upon a chafing-dish, in which there is a moderate fire, observing to hold it so that it may not burn; to do which more commodiously, a prop is used, and some-

times two, or even four, as we shall see below. These props should be fixed to the edge of the plate, in some place where there is no engraving; and the plate being thus supported, must be left over the fire till it be so hot that the varnish, being brought in contact with it, may melt and run through the taffety which is wrapt round it. Then take some of the soft varnish well wrapt up in taffety, that is free from all grease and dirt, as also strong and found in every part; for, indeed, it ought to be new, that there may be no weak or worn place in it, where the varnish may run through in too great plenty. With the varnish, thus inclosed in the taffety, rub the plate, first as before described over the fire till it grow hot. In doing this, it should be gently passed from one side to the other in a right line, so as to form several rows, till such time as the plate be every where moderately covered. After this, with a sort of ball made of cotton tied up in taffety, beat every part of the plate gently, while the varnish be yet in a fluid state; and to unite it still more, and give it a finer grain, it is proper to take the plate from the fire immediately, and continue striking it on every part with the ball till it attain a harder consistence in cooling. This must not, nevertheless, be prolonged till the varnish be too cold, for then the ball would be apt to make it rise from the plate.

When the plate is thus uniformly and thinly covered with the varnish, it must be blackened by a piece of flambeau, or of a large wax candle, which affords a copious smoke; and sometimes two, or even four, such candles are used together for the sake of despatch, that the varnish may not grow cold, if that were possible, during the operation. The plate must then be heated again, in order to the varnish's being blackened, that it may be in a melted state when that operation is performed; but great care must be taken not to burn it, which, when it happens, may be easily perceived by the varnish smoking and running into little lumps, as if it had contracted some foulness. The following expedient is made use of, for the more commodiously blackening the varnish, being particularly necessary where the plates are large. Fix a strong hook in the beams of the boards

of the roofing of the room, through which pass four pieces of cord of equal length, at the end of which are fixt four iron rings of about four inches diameter. The four props, which hold the corners of the plate, must be fastened to these rings, and the plate, being thus suspended in the air, with the varnished side downwards, may be blackened with great convenience. But this is not, however, absolutely requisite, except in the case of large plates, that could not, without difficulty, be held up, unless this, or some other such contrivance, were made use of.

It is proper to be very cautious in keeping the flambeau or candle at a due distance from the plate, for fear the wick may touch the varnish, which would both sully and mark it. If it appear that the black have not penetrated the varnish, the plate must be again placed, for some little time, over the chafing-dish; and it will be found, that in proportion as the plate grows hot, the varnish will melt and incorporate with the black, which lay above it, in such manner that the whole will be equally pervaded by it.

Above all things, the greatest caution should be used in this operation to keep all the time a moderate fire, and to move frequently the plate, and change the place of all the parts of it, that the varnish may be alike melted every where, and be kept from burning. Care must also be taken, that during this time, and even till the varnish be entirely cold, no filth, sparks, or dust fly on it, for they would then stick fast and spoil the work.

S E C T. VI.

Method of applying the Hard Varnish on the Plate, and of Blackening and Drying it.

THE plate being perfectly cleansed, and freed from greasiness, by the means before directed, it must be put on a chafing-dish, containing a small fire; and when it is become moderately hot, it must be taken off again, in order to receive the varnish, which must be thus laid on. Take a proper quantity of the varnish, and putting it on the end of the finger with a stick, or

other small instrument, touch the plate with it gently, in order that it may be spread in small spots of the same size, at as equal distances as possible over every part; and if the plate cool too much before the whole be finished, heat it again as at first, carefully preserving it, nevertheless, from any dust or foulness whatever that may be liable to fall upon it. When this is done, having made the fleshy part of the hand, below the little finger, thoroughly clean, beat gently with it on the plate, till all the spots of the varnish are driven together, and cover equally and uniformly the whole extent of the polished surface.

After this beating the varnish, the same part of the palm must be passed over it, in a sliding direction, as if to clean it, in order to lay the varnish yet more smoothly and equally. But the greatest caution must be observed with regard to two points. The one is, that the varnish lie very thin on the plate; the other is, that there be no sweat on the hand, because the moisture would stick to the varnish, and when it is to undergo the effect of the fire, would make, in boiling, little holes in it, that are almost invisible; and which, without great care, when the *aqua fortis* comes to exercise its force on the work that has been engraved, would, at the same time, exert its power on the copper, in these little holes.

The above are the directions given by Mr. Le Bosse for performing this operation. But spreading the varnish on the plate with the hand is subject to great inconveniences, as he himself has remarked in more than one particular. First, in that of burning the hands, which is scarcely possible to be avoided. Secondly, in producing little imperceptible holes in the varnish, which suffer the *aqua fortis* to reach the plate in wrong places, and eat spots in many places of the copper. To avoid these accidents, it is better, therefore, to spread the varnish with a little ball, or puff, made of the cotton and taffety, as is done in the case of the soft varnish.

The varnish being then equally spread in this manner, the way to blacken it is to take a large candle of good tallow, which is well lighted, and does not emit

any sparks, and to fix the plate over it, with the varnished surface downwards, supporting it by resting one of the corners against a wall, and holding the other in the hand, and observing also that the fingers do not touch any part of the varnish. The candle, by this means, being kept perpendicularly under it, the flame will rise against the varnish, and may be suffered to approach it as near as possible, provided the snuff do not touch it, and in this manner it must be moved under every part of the varnish, till such time as the whole shall be made sufficiently black; but the candle should be snuffed when there is occasion, in order that it may afford its smoke more copiously. This being finished, the varnish must be baked or dried in the manner below directed; but, in the mean time, it should be placed where it may be safely preserved from all dirt.

This also is the direction of Le Bossé for blackening the hard varnish, and it is a very expeditious manner, except in two points. The one is, that, instead of a tallow candle, it is much better to employ a piece of flambeau, or a candle of unbleached wax, folded into two, or even four parts, and lighted at the end of each, in order to raise a more plentiful smoke. The other is, that, instead of holding the plate in the air with the hand, which is very troublesome when it is large, and when small occasions frequently the burning the hand, one or more props should be used for the supporting it more commodiously, and preventing these embarrassments. The method of doing this may be found in the instructions already given, p. 81, for the management of the soft varnish; the operation being the same in both these cases.

The plate being thus blackened, the next concern is to dry or harden the varnish; to which end it is proper to have a quantity of burning coals that send out no sparks, or at least as few as possible, and to prepare a coal pan of the shape of the plate, but bigger every way, to place it over. The operation may be performed in a chimney, by the assistance of two dogs to support the plate over the pan of coals. But before it is put there, a napkin, or some such thing, should be fixed above, to spread over it, to prevent any dirt of the

chimney from falling afterwards on the plate. It is proper to be particular in the manner of preparing the pan of coals, and drying the varnish, because it is a matter of consequence; and it may be thus performed.

In the first place, the coals being kindled, and burning in such manner as neither to flame nor emit sparks, they must be placed in a form resembling the shape of the plate, but in a greater compass, by four fingers on every side, putting the greatest part of them to the extremities, and leaving but very few in the middle.

The fire being thus adapted, the plate must be put cross it on a pair of tongs, or other such utensil, to rest by that means on the dogs directly over the middle of the pan. Being left there for the space of betwixt half a quarter and quarter of an hour, allowing most time in winter, the varnish will appear to smoke; and when the smoke is found to decrease, the plate must be removed from the fire, and touched at the side on the varnish with a pointed stick, or little piece of hard wood. If the varnish be easily raised by the touch, in consequence of its being too soft, the plate must again be put over the fire, as at first. When it has been there a small time, it must be touched as before with the stick; and if it do not rise cleanly, but with some force, the plate must that instant be taken from the fire, and left to grow cold. But if, on the first trial, the varnish resist very strongly to the stick, water must be immediately thrown on the back of the plate, to cool it as quickly as possible, lest a longer continuance of the heat render it too hard, and burn it. It should be remembered most particularly, while the plate is over the fire, to prevent all ashes, or any kind of dirt, from getting to it; for otherwise, they would stick so fast to it, that they could not any way be taken off; but after the hardening is finished, no mischief of this kind is to be much feared, since if, by accident, the varnish contract any foulness, it may easily be wiped off with any thing soft.

When the varnish is thus heated, and proves to have grey or rough spots, they may be made black and smooth as the rest by rubbing them with the end of the finger, and a little tallow, or the mixture below directed, and afterwards heating them gently, and then pres-

ing hard upon them the palm of the hand in every direction.

S E C T. VII:

Method of making the Varnish White, where that Colour may be preferred to Black.

THE method of whitening the soft varnish is thus: Take of white lead well ground in water, and put it into a glazed earthen dish with a little good glue dissolved. Put the dish over the fire, and melt and heat the whole together. After which take this white, which ought to be moderately clear, and with a great brush, or pencil of hog's hair, spread it as thinly and equally as possible on the varnish laid on the plate, and smoothed as above directed, p. 83. Let the colour then dry, laying the plate, in the mean time, flat on some proper support. If the white appear to take with difficulty on the varnish, there is nothing more required to remedy this default than to put a drop or two of ox-gall into the composition, and to mix them well together with the brush used for spreading the colour.

The same manner may be practised with the hard varnish, only it must be first hardened and dried, the blackening being omitted.

Mr. Cochin observes, that there are some, nevertheless, who assert, that the blackening is advantageous, even where the varnish is to be whitened; because, in the engraving afterwards, the hatches would appear darker, and consequently be more perceptible and distinct to the eye. But to this he answers, first, that the black prevents the white from taking hold of the surface, and that it is not safe to put too much gall, for fear of spoiling the varnish; and secondly, that, supposing the white would take hold, it would only appear grey, because of the blackness under it, at least unless it was put on so thick as to spoil the whole.

When the varnish is whitened, powdered black lead is preferable, in the calking or over-tracing, to the red chalk, for rubbing on the back of the drawing, or the paper interposed betwixt the drawing and the varnish.

When that which was intended is engraven on the whitened varnish, it is proper to take off the white before the *aqua fortis* be put on the plate. This may be done by putting a little common water, heated somewhat more than warm, on the plate; and, with a soft and clean sponge, or rather with the fleshy part of the fingers, rubbing upon the white, that it may be every where moistened, and then washing off the whole with more water copiously used, and afterwards drying the plate.

To preserve the white varnish from injury during the time of engraving, it is proper to put upon it a piece of cloth or serge of very soft wool, instead of paper, or, what is better, a piece of damask linen.

If it be desired to take off the white before the engraving the plate, it may be done by putting some of the refiners, or strong *aqua fortis*, lowered with water upon it, and spreading and corroding it, water must afterwards be put on it, to cleanse away the whole, and the plate must be dried, and may be used as if it had not been at all whitened.

S E C T. VIII.

Method of Calking and Retracing the Design on the Varnish of either kind.

MR. LE BOSSE mentions two methods of calking on the varnish; the one, by drawing the design upon it by red chalk: But, as he observes, it is very difficult to find such as is very soft and fat, and will not score or scratch the varnish, he gives it up, except in over-tracing, for repairing any thing imperfect, or supplying any thing omitted after the calking by some other manner. He therefore recommends the other method, which is this: Draw very correctly with a crayon, pen, or pencil, the design upon good paper, and redde it afterwards on the back with good red chalk powdered, by spreading it on the paper, and rubbing it with a piece of linen, in such manner that the colour may lie equally on every part. Then having taken off all the

powder which is loose on the paper, pass the palm of the hand seven or eight times over it, that the red chalk may stick fast to the paper, and not daub the varnish. If in any case it be necessary to oil the drawing, as it often happens when the design is turned to the right hand, and consequently, being engraved, would come to the left; or if otherwise, when it ought not, it may not be convenient to suffer the design to be spoilt by putting the red chalk on the back of it; a piece of very thin paper should be procured of the exact size of the drawing. This paper should be rubbed with the powdered red chalk instead of the back of the drawing; and, being laid on the plate with the red side towards the varnish, the drawing should be put over it, and fastened to it and the plate, in such manner that none of them can be moved from each other, or vary, with respect to the situation of their parts, from the manner in which they were at first fixt. To do this commodiously, the best method is to stick them together with sealing-wax, or some other such substance. The drawing to be engraved being thus laid on and securely fastened to the plate, the manner of the proceeding, in the calking it, is as follows:

Take a stiff or calking needle, such as described p. 66, and pass over the outline of the figures which compose the design, bearing strongly and equally upon every part, especially where two papers are in question; for, if the drawing itself be reddened on the back, there is not occasion for the same force as when another part, either oiled or not, is added; but if the drawing be not reddened, and the colour be on another paper, which together with the drawing, makes two under the stiff, there is consequently occasion for double the force that would be wanting if it was only exerted on the paper of the drawing alone. This being done, it is proper to examine that all the outlines of the drawing, over which the stiff has been passed, be marked, imprinted, or calked on the varnish of the plate. After which, if the drawing itself was reddened on the back, it should be taken off, by lifting it up perpendicularly and straightly from the plate, carefully avoiding its rubbing in the least on the varnish; and, if the colour be on

another paper, the drawing must be first removed, and then that must be lifted off with the same care. The varnish being thus uncovered, the traces of red which are formed upon it must be gently struck with the fleshy part of the palm of the hand; and as this is doing, the palm of the hand should be wiped from time to time with a clean linen cloth, to take off the red that may stick to it, and prevent its being carried from one part of the plate to the other. Being thus beaten in every place, it will be found that the outlines, which were red before, will have become whitest, and be fixed firmly to the varnish by this treatment.

A large brush pencil of the kind mentioned in speaking of the instruments, or, what is better, the feathered part of a large goose quill, must be then used to wipe or sweep every part of the varnish, so that not the least foulness may remain; and to do this the better, it is proper to lay the plate on a desk, or other such sloping surface.

When a picture or drawing is intended to be engraved on the same size, and turned the same way on the plate, so that the print will be turned to the opposite or contrary side to that of the original, a thin piece of paper varnished with the Venetian varnish, very dry and transparent, must be fixed to it. Upon this paper, the lines of the original, which will appear through it, must be marked with a crayon of red chalk, and afterwards calked upon the varnish, by reddening the back of this varnished paper, or by interposing another paper, not oiled, but reddened according to the manner above directed, betwixt the oiled paper and the varnish.

The methods of calking may be practised in the same manner on both the kinds of varnish, only it is proper to be cautious, in the case of the soft varnish, not to bear too strongly on the stift, which is, nevertheless, very allowable with respect to the hard, as it would stick the paper to the varnish, and spoil it.

The back of the design, or of the oiled or other paper, where such is used, instead of being rubbed over with red chalk, may be coloured with white lead, where

the tracing may be more agreeable of a white colour than red.

This is the method of calking, when the print is intended to be turned to the contrary side with respect to the picture; but more particular directions concerning the manner will be found in the first volume of this work, under the article of CALKING. When the print is intended to be turned the same way with the picture, or drawing, the design must be counter-proved upon the varnish by the method directed in the next section.

When it is designed to engrave a design less than it is in the original, a certain number of squares must be slightly traced with a crayon on the picture, print, or drawing, over the whole surface; and the same number of squares must be made likewise on the paper, which is to be the ground of the designed sketch, but diminished in the proportion the original is intended to be reduced. Afterwards the sketch must be drawn by the eye, taking care to place every part, found in the original, in the square which answers to it in the paper or ground of the sketch. This is called by artists *reduction by the square*; but this and several other methods of reduction are explicitly described in the first volume of this work, under the article REDUCTION.

SECT. IX.

Method of counter-proving the Design upon the Varnished Plate, in order that the Print may be turned the same way with the Picture, or original Drawing.

AFTER having taken the drawing on the varnished paper, in the manner above mentioned, with very soft red chalk, or rather with red ink, made of red chalk tempered with water, a piece of paper must be had of the same size as the drawing, and dipt in water, just as the same manner as if intended to receive the impression of a print, directions for which are given below. The drawing must also be slightly moistened with water; but caution must be observed to prevent its soaking through to the side drawn upon, as that would

hinder the chalk from giving the counter-proof. The drawing being thus prepared, a copperplate must be taken, of at least an equal magnitude, that when the drawing is laid upon it the sides may not reach beyond it. This plate must be put upon the table of a printing-press, not forgetting to cover it with a piece of moistened paper that will fit it, to hinder its dirtying the drawing which must be laid on the plate, with the side drawn upon upwards. The drawing must then be covered with the white paper, prepared to receive the impression, and some leaves of blotting paper, or grey paper, moistened also, being laid over it, several of the cloths or blankets, used by the printers, (of which there will be occasion to speak more particularly in treating of the manner of printing copperplates) must be laid softly over the whole, which may then pass under the press. It may even undergo the action of the press several times, to render the counter-proof more strong; which being done, and the drawing uncovered, it must be examined how well it has marked the white paper. The paper, while fresh recalked in this manner, should be put immediately upon the varnished copper, without giving it time to dry, and pass under the press, for it can be no more used as a counter-proof; and the press should then be well closed upon it, by turning it slowly and equally, in order that the chalk may the better mark the varnish. But the plate should only pass once under the press, for fear the strokes should be made double. When this operation is finished, it will be found that there is a counter-proof of the drawing on the plate, turned the same way as it was designed in the drawing, or the original picture, but with much more spirit than can be given by calking with a stiff.

To place the paper, containing the counter-proof, more exactly on the plate, the drawing ought to be marked at first with four lines, strong and easy to be re-calked, in the middle of the four sides; which may be done by delineating cross the drawing two lines, the one lengthways, the other crossways, that intercept each other at right angles in the centre. The four middles of the four sides of the varnished plate should likewise be marked at the same time, on the edge of each side.

A counter-proof of the lines on the drawing being marked, along with the rest of the design, on the white paper, it must be prickt at the extremity of them with a pin, in order that, in placing it afterwards on the plate, one may see on the back where these lines which mark the middles are, and put them exactly opposite to those which are marked on the edge of the plate. The counter-proof should be fastened to the sides of the plate with a very little wax; because, otherwise, being crushed under the press, it may be spread to the places that require to be engraved.

There is sometimes occasion that the parts of a print should be on the same sides as the picture, or original drawing, as there must always be, when any action is to be represented that is done with the right hand, and which would otherwise appear in the print to be done with the left, if it was engraven on the plate the same way as the original. In such case, the counter-proof must be immediately made from the sketch on the plate, without re-calking it first on the white paper, as was above directed; and, on this occasion, the sketch may be drawn with white lead, which will mark it sufficiently on the varnish; but would not do so well where paper is in question, nor could not, besides, admit of giving two impressions. By this means the print will be brought to turn the same way as the picture; but it is necessary then to engrave with a looking-glass, as we shall explain below.

When the sketch is to be calked in the same manner upon the plate as it is drawn after the picture, and there is no occasion to make a counter-proof, this must be done. It must be drawn upon the varnished paper, and that side of the paper, which is drawn upon, must be turned towards the plate; and having put betwixt them a paper, coloured as above with red chalk, the sketch, thus turned a contrary way, must be calked in order that it may come the right way in the print.

To engrave with a looking-glass, when the sketch is re-calked on the plate, in the direction opposed to the original, the picture or drawing must be put before the glass, and placed betwixt it and the person who engraves, in such manner that the back may be towards

him, and the front towards the glass, and then the design will appear turned the same way as it is marked on the plate. But this, nevertheless, is not practised, except in engraving small subjects; for it becomes inconvenient when any larger picture or drawing comes in question; and it is therefore better in such case to use a counter-proof.

Whatever method is pursued at first in marking the sketch upon it, the varnish must be always re-melted, to hinder its being effaced. This is done by heating the plate with paper burnt under it, moving it from time to time, that it may not be heated more in one place than another, and that the varnish may not be burnt. When it appears to be melted in an equal manner every where, the plate must be removed, and set by to cool in an horizontal position.

SECT. X.

Of the general Manner of Engraving on both kinds of Varnish.

THERE are several things to be considered in engraving, as a variety of lines and hatches are to be made of different magnitudes, some straight, and others curved. It must be imagined, that to make very small lines, very small needles must be used; and for the larger, such as are bigger, with a larger point, and so of the others. But it is necessary to observe this, that, with a large needle, whetted to a short point, it is difficult to make a large stroke, except by three ways. The first is, by bearing very strongly on the needle, the point of which being short and thick, it makes itself a very large passage; but if this manner be well considered, it will be found, that the stroke cannot come out neat and fair; because the round of the point does not cut the varnish, but thrusts it forwards before it. The second manner is, by the making several strokes extremely near each other, and enlarging them at several different times; but this is tedious and difficult. The third consists in making a stroke moderately large, and

leaving the *aqua fortis* on it a long time; but there is more to be said with regard to this, as will be shewn in its proper place.

The above are the directions of Mr. Le Bosse; who adds, that, from the experience which every day afforded him, he found that the oval-pointed needles were more proper to make large strokes than the round-pointed; because they cut by their side, which the others are not capable of doing. He further proceeds in his instructions, thus:

The round-pointed needles for engraving should be whetted very round, in order that they may turn freely on the plate; and, above all, they should have their points very keen, that they may cut the varnish and copper cleanly on every side; and if it be perceived that the needle does not pass freely every way, it may be taken for granted that it is not whetted round.

If lines or hatches, whether straight or curved, are to be made of the same thickness from one end to the other, common sense dictates that it is requisite to bear equally on the needle in traversing the whole length of the stroke.

If strokes are to be made that decrease during their whole length, it is easily conceived, that the method of doing it is to bear more strongly on the needle at first, and to diminish the force gradually in advancing to the further part, lightening the hand continually, and gradually, from one end to the other, according to the inequality of the thickness desired.

If it be required to make strokes that are thickest in the middle, and grow gradually smaller towards the extremities, it must be done by bearing lightly on the needle at first, but increasing the force till the middle of the stroke be formed; and then lightening the hand in proceeding towards the other end, in the same proportion as the force was augmented in passing from the opposite end to the middle.

What has been here said of the three sorts of strokes, which make six sorts of lines, suffices for all the forms of hatches that can occur in shading any design whatever.

If it be desired that the work should resemble that done by the graver or tool, the needle must be very strongly borne upon, where it is required that the hatches should be broad, and very gently in the places where they ought to be narrow; for, it is very evident, that when the work is made on the varnished copper, and the *aqua fortis* applied, it will hollow out more readily, and powerfully, the strokes or hatches where the needle has been borne upon with greater force, than in the other places where nothing more has been done, than, as it were, removing the varnish. But then there must be some other aid given, as will be shewn hereafter, in speaking of the hollowing effect of the *aqua fortis*; and by this the work may be executed according to the full intention.

If, after engraving with a small needle, it be required to enlarge the stroke more, it is necessary to go over it again with another needle that must be short and thick, according to the largeness of which the stroke is wanted, and to sink deep with it the thickest places of the hatches. This is to be done in the case of the round-pointed needles, but more principally in that of the oval-pointed; and by proceeding in such manner, the plates will afford many impressions.

It remains to treat of the manner of taking assistance from the use of the *echoppes*, or needles whetted to an oval point. They avail when it is desired to enlarge, or render thicker, any hatches or strokes, or where hatches or strokes are required to be of such thickness, that the laying aside the round-pointed needle is unavoidable. This should never be done, however, but where there is found an absolute occasion, as the round-pointed enter much more keenly into the copper than the oval-pointed. The excessive thickness of the strokes, which is requisite to be made on certain occasions, often creates, nevertheless, the necessity of having recourse to oval-pointed needles; in which case, all that is to be done, as I have said before, consists in this; that having made the thick strokes with the oval-pointed needles, they must be strongly retouched with one of the largest of the others, whetted to a short and round point in the

middle; and this is to be done principally in the places where they are the broadest.

The manner of holding the oval-pointed needle is the same as that of holding a pen, except that the face or cut part of the pen is turned towards the palm of the hand, and that of the oval pointed needle generally towards the thumb. This is not, however, because it is impracticable to turn or manage it in any other direction, for the oval or flat part may be turned towards the middle-finger; but because it is the most convenient method of handling the instrument, and affords also the means of using great force with steadiness.

There are some engravers, who, having made narrow strokes with round-pointed needles, retouch them again with the oval-pointed, in order to make them broader in the necessary places. But it is better to make them first with the oval-pointed, and then to retouch them with the round-pointed; because the latter enters better into the hollow traces left by the first than they in those made by the latter; and the lines which are made this way are much more cleanly cut.

Those who are capable of using the graver, may enlarge the hatches with it, after the *aqua fortis* has had its effect on the work, better than by the method just mentioned, and the strokes will be much fairer. It is proper to add, that, in engraving on the varnish, the needles, both round and oval-pointed, should be held as perpendicularly, or straight on the plate as is possible. The habit also should be acquired of moving them briskly, that the hatches may be more clean and steady; and, on this account, the instruments should never be used but when they are well sharpened, and in the best order, to keep them in which, they should be often whetted.

It may be likewise well to subjoin, that the softenings which are given to the lights in any design, as also all the distant objects, ought to be worked with very small needles, and a gentle force on them; but the lines should be strongly sunk in the places that ought to be more striking to the eye, as the shades, to the end that a great part of the softenings and distances may be covered, after having been corroded a short time by the *aqua for-*

ris, in the manner below directed ; for it is obvious that the needles, which have made the hatches near the lights, have had very little effect on the copper ; so little, indeed, as scarcely to take off the varnish ; for which reason, in applying the *aqua fortis* to them, it corrodes or hollows less strongly by much there than upon the strokes that have been made with more force, in such manner, that having covered, at the same time, all the distant objects, the places, thus strongly touched, will have more effect than the others. The doing this judiciously, makes one of the principal points of skill in the art of engraving with *aqua fortis*.

One thing more may be likewise added, that it is necessary to be careful to brush, or wipe off, with a large pencil, or, in default of such, the feathered part of a quill, all the small parts of the varnish or copper which the needles have cut off in the graving, that they may not stick in the hatches, for that would cause scratches to be made upon the varnish, in moving the paper, which is put to preserve it in leaning upon it.

The manner of engraving on the soft varnish is much the same with that of the hard, except that it must be done more delicately, and with greater precaution, to prevent damaging the face, on account of the softness of the substance, which makes it more susceptible of injury, from slight violence. The needles also may be the same in both kinds of varnish, though some painters reject the oval-pointed in the case of the soft, notwithstanding they are very useful, especially in engraving architecture. But this must be left to the choice of each artist, as it may suit his own particular manner of working. The use of the oval-pointed needle is indeed good for engraving every thing that admits of a coarser manner, as ground, trunks of trees, walls, &c. which demand strength with nibbled work, as we shall see hereafter. It may be remarked here, that though this instrument seems fit for making large strokes, it may nevertheless be used also for making the most fine and small, by holding it on the straightest side ; and if any person be well practised in the use of the oval-pointed needle, they may completely etch a whole plate, without any other instrument, by furrowing it, more or less,

according to the largeness of the strokes they would make.

The greatest care ought, as has been just before intimated, to be taken, in preserving the soft varnish on the plate; for it is very liable to be scratched or bruised in the engraving, by the rubbing or touching with any hard body. There are several methods, however, of securing it; of which, one is to have a kind of desk, where the plate may be put; and fixing a frame, or rail, on the desk, on each side of the plate, to lay narrow broads cross them; on which the person engraving may lean without touching the part of the plate which is betwixt him and that he is working upon.

Another method used by some is, to work with the plate upon a kind of easel, in the manner of the painters, and it is a very good manner; but few persons can soon accustom themselves to it. The most easy way is to have a table, in the manner of a desk, and putting a proper piece of either white or brown paper on it, to lay the plate upon the paper, and with a linen napkin of diaper, or damask, used till it be soft, and folded very even, to cover that part of the varnish which requires it in the graving. The napkin should be very soft and pliable, and folded into four doubles; and it serves extremely well to rest the hand upon in working, as the leaves of paper in the case of the hard varnish. Instead of the linen, a piece of sheep's skin, dressed in oil, may be used, with the soft side turned towards the varnish; and, on leaving off working, all the plate may be covered with this skin, to prevent any dirt falling on it, or other accident damaging it. What is most to be feared in this method, is the leaning too strongly on the napkin or skin; because the buttons of the sleeves of the coat, or of the shirt, may easily, in bearing on it, hurt or spoil the varnish; for which reason, they who work in this way should never have buttons on the under part of their sleeves, or should at least be very careful about them.

If it happens that, by some unlucky accident, the varnish is scratched in any part of the plate, the injury must be repaired by taking the Venetian varnish, commonly called the painters' varnish; and, having temper-

ed it with a little lamp-black, to cover, by means of a small pencil, the scratches, flaws, or false strokes, with the mixture. This invention, which is of a late date, is extremely useful, as the plates thus repaired may be equally well graved upon; and the *aqua fortis* will do its office there as effectually and cleanly as in any part of the varnish; for which reason, if any fault is made in the work, by putting hatches where there ought to be none, or turning others the wrong way, they may be covered in either a greater or less space by this mixture; and, when it is dry, may be engraved afresh; and this may be repeated on the same part, where necessary, without the least inconvenience, for any number of times. The varnish used for this purpose should be new, for keeping renders it thick, which prevents its covering so evenly what is employed to deface; and, when any place is covered with it, great care ought to be taken not to press too strongly on the napkin or skin laid over it till such time as it be perfectly dry, not only for fear of bringing it off by its sticking to them; but also, lest any lint, or wool, may be left by them upon it, which would hinder its being engraved over again in a proper manner.

If the varnish scale in working, that is to say, will not suffer itself to be cut cleanly, but rises in small flakes, as happens more particularly in winter, it is a proof that it is too hard. In such case, the flaws, or part where it has scaled, must be covered with the Venetian varnish, or lamp-black, as has been above directed; and a gentle fire of hot ashes must be put betwixt the table and the board on which the plate lies to be engraved, to soften it by the warmth, and render it more yielding to the needle.

With respect to those who work on the soft varnish, with the plate put on an easel, they do not run the same risk of having the varnish bruised, nor have occasion so frequently to wipe the plate; because, being placed obliquely, the little scales of varnish, raised in the graving, fall off of themselves. The easel may be the same as that used by the painters; and the only difference in the whole is, that in one case a pencil is used, and in the other a needle; except that it is necessary, in the

case of engraving, to have the easel strong, and very firmly fixt, that it may not shake or give way in bearing strongly against the plate, which is necessary in a greater degree where large strokes are to be made. It is said that Callot worked in this manner on account of his health, which he supposed to suffer from a more bending posture; for which notion he had probably great reason, as many others may have in parallel circumstances.

Notwithstanding the most ancient, and the most common manner of engraving, is to use needles which cut, and make some impression on the copper; yet there are, nevertheless, very able gravers who employ needles that do not cut at all; and this practice appears advantageous with respect to the effect that the strong *aqua fortis* has upon the varnished plate; for it often happens, in tracing an outline, or in some touches made with a cutting needle, that the exactness with which it is endeavoured to be done, occasions, without its being perceived, a greater bearing on the needles, so as to make it enter more deeply into the copper in these places than in any other, which causes them to be more corroded than the rest, and produces spots too sharply marked; instead of which, the blunter-pointed needles, not hollowing the copper more in one place than another, suffer it to be almost equally corroded every where, according to the proportion of the needles employed, and consequently produce a grey effect, very advantageous for touching properly on some occasions.

On the other side, it may be said, with respect to making an impression on the copper, that it gives more spirit and firmness, than when the needle only glides over the surface, and has no hold of any thing; for which reason it is expedient, where a plate is prepared for great designs, and the graver is to have a considerable share of the work, to make use of blunt needles, and to confine those with cutting points to engravings in small, which ought to be prepared differently, as we shall see below. It is to be remarked, with regard to the needles which cut, that they should be borne hard upon in making the hatches that form the masses of shade, without which they become lean; for in propor-

tion as the stroke is intended to participate of the largeness of the needle with which it is made, almost all the sharpened part of the needle must be introduced into the substance of the copper, otherwise a large needle and a small one would make strokes of nearly the same breadth; but however large the hatches may be made, it is proper, nevertheless, to put many of the seconds, below spoken of, into the shades before the first corrosion, that the *aqua fortis* may give all the possible assistance to the force of the effect, which, after long corrosion, would be slight from one stroke only.

SECT. XI.

Principles respecting the manner of Engraving, with the methods applicable to particular subjects.

THE plate being prepared and calked, the terminations of the shades and demi-teints should next be marked out. But the artist himself should calk the design, and never trust it to others, in order to have it as correct as possible; for though errors might be amended in the engraving, yet it is better to be certain of a true guide than to grope out the way, especially as unavoidable faults enough will be committed, after the most assiduous care, without giving room for more, by the neglect of due precaution.

Engraving differs from drawing in this, that in the first, they begin by preparing the soft shades, and give afterwards the touches upon them; but that, in the latter, they put the touches first, after which they add the shades to them. The reason is, because they cannot re-enter the strokes in the soft varnish, which has not resistance enough to keep the needle steady, and prevent its deviating from the line of the stroke already made. It is not necessary, however, to draw every where with the stiff the sketch of that which is to be engraved; because it may prove, in the progress of the work, that parts may be, in that case, traced which were not necessary. The little parts should therefore be traced, according to the occasion there may be, to place the shades in marking the principal touches and the side

of the light should be afterwards drawn with a very fine needle, or even by small dots, or stippling, (as the working with such dots is called) if they be in the case of flesh, forming strokes only in the places which ought to be more apparent. These strokes ought also to be accompanied, if in the case of flesh, by some points or dots; or, if in draperies, with other strokes or hatches, that they may not be lean and hard by standing alone. Engraving is at the best but too hard of itself, on account of the necessity there is to leave white between the strokes; for which reason it should always be made an object of pursuit to find out the softest and richest manner possible, as it is not practicable to make a thick and full stroke, that will not at the same time be black, to imitate the softness of the pencil or crayon, which make them broad, and yet, at the same time, tender, it is necessary to make use of several very narrow strokes, the one at the side of the other, or of points, or small dots, to accompany what is traced with a very narrow line, as a shade, that it may be sweetened by them. The same thing must be observed in the touches of the shades, and care must be taken, that the lines, in the middle of a touch, be made stronger than those at the extremities. The shades are engraved last by hatches ranged in a regular order.

Engraving being to be considered as a manner of painting, or drawing with hatches, the best and most natural manner of taking the strokes is to imitate the touch of the pencil, if it be a picture that is copied; and there is scarcely any picture done in a masterly way, where the management of the pencil is not discoverable. If it be a drawing, the same manner of hatching should be followed as if it was copied with a crayon; but this is only with respect to the first order of strokes; for, with regard to the second, it must be gone over in the manner that best constitutes the form conjointly with the first; and, by its assistance, strengthens the shades, and terminates the edges of them, in a manner a little flat, that is to say, a little cut, and without sweetening. This must not be continued in the reflections when they are tender; but they should be left a little more light than they ought to be when the plate is finished, re-

serving to the graver, which ought to complete the work, the business of lengthening these strokes to darken the reflections, and take away from them the transparency, which renders them too like to the parts that are in full light. If the shade be very strong, and the reflection also, it must then be engraven with two strokes, by a large needle, and the reflection, in the same manner, with two strokes, but by a smaller needle.

In the forming the strokes, where there are several orders, these rules should be observed.

The first stroke should be made strong, bold, and close; the second a little finer and more distant; and the third yet smaller and more free or wandering. This may be either done with the same needle, by bearing more or less strongly on it, or rather by changing the needle, and using such as are of a different thickness, if the subject that is engraved abound with bright and fine colours. When the double and triple strokes are nearly alike, they produce a dull and heavy colour, which does not attract the eye; and, on the contrary, when they are unequal with respect to each other, they make a more pleasing work, and such as is better adapted in the parts where the light falls in the linen, in rich stuffs, &c. The first stroke ought not to be stiff, it is to give the form; the second is, as it were, to paint; and the third to soul and destroy certain things, that the work may not be every where of equal beauty; it serves also to glaze the strong shades, which, without that, might be of too hard a nature; but it should be used with discretion. If the first and second be square, the third stroke ought to be in the lozenge position, upon one of the others; and, on the contrary, it should be square upon one of the two, if they be in the lozenge form, in order that there may be always a square upon one, and a lozenge upon the others, which produces a grain that is very soft and in good taste. In engraving with the *aqua fortis*, a third stroke should seldom or never be made; because something should be left to be done by the graver, that the print may prove of an agreeable colour; besides, it frequently happens, that the corroding too much renders it blacker than it should be;

for these reasons, we will confine our consideration here to the two first.

The second stroke ought to be laid on the first, more or less, in the lozenge figure, according to the nature and character of the subjects that are engraved. Flesh, for example, ought to have half lozenges, that the third, coming to finish, may have a good effect, which cannot be if it be laid on hatches that are square to each other. The lozenge ought not, nevertheless, to be carried to excess, because the angles where they join become too black, the *aqua fortis* acting more powerfully there than elsewhere. This would produce an engraving too coarse and foul, by the quantity of third strokes, or of points, which must be put into the squares to give them an unity of tone. And in engraving with *aqua fortis*, the artist should never lose sight of the manner in which the graver ought to finish the work, but should foresee, from the beginning, the effect that the re-touches will have, which are intended to be introduced.

As to other cases, the having more or less of the lozenge depends on the character of the flesh that makes the subject. If it be the flesh of muscular men, and who are painted in a bold manner, there is no danger of spoiling it by strokes thrown together confusedly, but a little inclining to the lozenge; but, on the contrary, the flesh of women require a more uniform manner of working, that may express the fineness of their skin, which a too large lozenge would break in upon.

There are, nevertheless, very able men who maintain the contrary, and assert, that the lozenge is less to be feared in delicate flesh than in that which demands a great strength of colouring, having found, when they would push the effect with more vigour, that the lozenges become incommodious. However it may be, square hatches should be above all things avoided, not being good for any thing but to represent wood and stone. It is true, excellent pieces of engraving may be found where the squares abound much; but that does not hinder its being a bad manner, and it is certainly not on account of this particular that they excel, for the lozenge manner must be allowed to be greatly softer. The finest examples that can be given, are the prints of Cornelius

Vischer, whose taste in engraving is, without exception, the best that can be chosen for imitation.

Draperies ought to be engraven on the same principles as flesh; the strokes should be taken in such manner that they may express well the folds; and to that end it is not proper to be confined to continue a stroke, which has served well to form any thing, when it is no longer fit to delineate that which succeeds. It is much better to break it off there, and to begin another which may be more suitable; observing, nevertheless, that they may serve for seconds one to the other, or at least for thirds. If it happens to be favourable for a second, it may be passed above the other with a very fine needle; if fit only for a third, the office may be left to the graver to lengthen it, and to lose it insensibly among the others.

In short, there must be nothing in this kind of engraving which favours of constraint; this continuation of the same stroke is the custom only in the works done by the graver alone, though even there it is not very necessary; and Bolswert, who excelled so much in that way, never embarrassed himself about the matter. It would, nevertheless, be very injudicious to fall into the directions of strokes diametrically opposite to each other in the same piece of drapery, when the separations caused by the play of the folds were not very distinguishable; for this would make a drapery which would appear composed of different pieces that had not any connection one with the other. It is this same opposition of work, joined to the different degrees of colour, that the original picture or drawing dictates, which serves to detach two different parts in any drapery, and to explain to the eye that they are not dependent one upon the other; for this reason the different directions of the strokes, which form the folds of the same drapery, ought to be made nearly in the same manner, provided that can be done without constraint, reserving the liberty of making them in a different direction, when the disposition of the draperies may discover the doubling of the stuff, for then this difference of the strokes serves to distinguish more clearly the upper or under part of the drapery.

The strokes ought to wind in a supple manner, following the play and the depth of the folds. It would be a bad method to form them only with one stroke, and then to lay another stiff and inflexible one over that, for the sake only of giving a blacker cast. It is better, on the contrary, that all the work which is introduced should have its own proper intention, and assist in constituting the figure of what is to be represented; at least, there should be only some things left in a dubious state, for the preserving the proper keeping of such others as ought not to attract the eye of the beholder. It should be particularly avoided not to make the strokes that terminate on the outlines, either of folds or parts of folds, end at right angles with such outlines, nor even in any manner approaching to it; but they should lose themselves in a lozenge, in such a way as may serve to render them less perceivable, and give a softer effect. With respect to the strokes which form the fore-shortenings, without knowing a little perspective, to conceive a right notion of them, there is a great hazard run of frequently taking them the wrong way.

The managing rightly the demi-teints should be a particular object of regard. After having steadily fixed the bounds of the shades, and in a manner a little cut, an arrangement should be made with a finer needle of the strokes which form the demi-teints; observing to put very little work, or at least in a very tender manner, in the masses of light, that the effect may not be impaired by such work; as, being too black and useless, it would only foul the parts that require to be kept bright. These strokes ought to be taken in such a manner that they may be connected with one of those of the shade; and if it be in the case of a demi-teint that is strongly coloured, and which requires two hatches, when the second cannot be joined with any of those of the shade: it is, however, proper that it should lose itself there, or serve in the place of a third. As to the rest, it is not necessary to take the trouble of joining with the *aqua fortis* such as are capable of being conjoined. There is a hazard of not doing it exactly enough, and the strokes not proving to correspond duly

with each other, would make, as it were, a furrow more black than is proper. It is much better to leave that work to the graver, which will unite them, and only, perhaps, render them too round.

One may venture to make some fine strokes with the needle near the light; but they must be more free, that is to say, more straggling from each other than those of the shades. In general, the strong lights, and those nearly approaching to them, should be kept from the *aqua fortis*, in order to leave something to be done by the softness of the graver.

Linen, and other fine and light stuffs, may be prepared with one stroke only, that opportunity may be had to give, with the graver, by places, a very slight and small second.

The points or dots that are made with the *aqua fortis*, to form the demi-teints of flesh, may be made in different manners, which all have a happy effect when they are disposed with taste. They are put in the flesh of men along the ends of, or between the strokes; or in rounds, which may be lengthened afterwards with the graver, though it is better only to intermix them with long strokes at the time of re-touching. In the flesh of women, only rounds are made with the *aqua fortis*, as the long ones would be of too coarse a work; but to prevent their being perfectly round, which would produce a tasteless and cold regularity, the needle is held a little obliquely in striking them. When great figures are engraved, a large needle is used, which renders the dots or points more full. In all cases the round points ought to be made with the *aqua fortis*, as it gives them a certain picturesque coarseness; which, mixt with the neatness of the graver, produces a better effect than the same round points would have, if made only by stippling with a dry needle. It is for this reason, that in the fine heads engraven by the graver alone, we see only long strokes, the rounds not being beautiful, except when they are formed by the *aqua fortis*. They are arranged something in the manner of bricks in a wall, the middle part being over a joint; and, above all, it is necessary to preserve great regularity; for whether it is that the thickness of the varnish deceives, or whether it be ow-

ing to some other cause, it happens that, in spite of all regularity which has been observed, when the plate is corroded, they are yet ill enough arranged; and if care were not taken to remedy it in re-touching with the graver, it would produce a flesh that would look milky. The points made with the *aqua fortis* ought not to approach too near the lights; room should be left to put in by the graver, or with the dry needle, the most minute that can be made; which may be continued insensibly even to the white. Long points, or rather very short strokes with roundish ends, may be put likewise into draperies, when very thick stuffs are to be depicted; and to give them that picturesque coarseness which distinguishes them from other stuffs more even, the hand is shaken a little in tracing the stroke, which gives it a waving that succeeds very well with regard to the effect; but this must be done without running into affectation. Great care should be taken, when any thing great is engraven, not to form the touches in the flesh, either of the head, hands, or elsewhere, with strokes so near one to the other as that the *aqua fortis* may make them run together, and form one of several. This would produce a sharp and foul blackness, which would require much trouble to be set to rights; for which reason the flesh should be prepared tenderly, and corroded but very little, in order that it may be finished more easily, and in a soft and pleasing manner.

The degradation of objects is also a principal matter of concern in engraving, and it is a rule founded on good sense and perspective, to bring the strokes more and more close, correspondently to the effect of such degradation, with respect to their distance. That is to say, having engraved figures, which are on the foreground of the picture, with a large needle, and full strokes placed moderately asunder, the figures which are in a second stage of distance, and deeper in the picture, should be engraved with a smaller needle, and the strokes brought nearer to each other. If there be a third stage, a still finer needle should be employed, and the strokes made yet closer; and this should be done even to the horizon, always preserving this idea of degradation. It is for this reason that the more distant

parts are generally covered with thirds, and sometimes even with fourths; because that fouls the work, and renders it, consequently, less apparent to the eye; besides that, taking away the little spots of white, which remained betwixt the strokes, closes the work more, and makes the objects keep back much better. This manner of engraving produces also a grey and dull cast, of great consequence to the keeping, which suffers the large and full work of the fore-ground to go better off, and gives it its due effect; but it is the office of the graver, rather than the *aqua fortis*, to execute it.

Fore-grounds are likewise engraven with strokes of different sizes, according as the case may require. Fine stuffs may be engraved closer; at least where they are not intended to receive inter-strokes; which, nevertheless, are very proper to represent silks, water, and metals, or other polished bodies. Thicker stuffs may be engraved wider; the part which is to be brown and dull, closer than that which is to be less full of work, and consequently the shades than the lights. This distinction ought not, however, to appear too sensibly, for fear something should be seen in the work of the fore-ground which might make it appear not of a piece with that of the black.

The expression of the great distance of objects claims, likewise, a peculiar attention; and it is a leading principle in perspective, that the more objects appear afar off, the less they ought to be finished. Nature is exactly correspondent to this. When we see a distant object, for example a figure habited, nothing is distinguished but general masses, and all the minuter parts, whether of heads, or folds of vestments, or even the different colours of such vestments, are lost to the sight. Engraving, which is only an imitation of nature, ought to follow her in all her effects, and render the objects it represents more and more formless, in proportion to their distance. For this reason, it is avoided in engraving distant figures to draw the forms with outlines strongly marked, and visible in many places, which would make them too distinct; but they must be traced by large parts, and as a first draught, and the shades by flat grounds, something in the manner by which a sculp-

tor sketches a figure of earth. The famous Gerard Audran has given admirable examples of this in all his works, as may be seen among others in the print of Pyrrhus relieved from danger, which he has engraved after Poussin, where he has given the broad and flat touch of the pencil, in the distant parts and back grounds, in a manner worthy to be admired. This seems easy enough to be done, and yet it is never found well executed but in the works of those who are consummately expert in the art. The greatest difficulty in the art, is not to finish and to work minute things up to the greatest point of exactness, but to know how to suppress advantageously all superfluous work, that nothing may be retained but what is necessary. It happens but too often that an engraver, seduced by the pleasure of doing a piece which may appear very carefully executed, amuses himself in finishing the head of a distant figure with pretty little points, ranged with much neatness; but he lavishes his pains to a very bad purpose; for this labour, which if bestowed elsewhere would have its merit, makes him commit a blunder against common sense, and the propriety of the design.

SECT. XII.

Of the manner of Engraving particular subjects.

EARTH, walls, trunks of trees, and landscapes, ought to be engraved in a manner extremely waving; in these cases, the square may be successfully mixt with the extreme of the lozenge, and the oval-pointed needles made use of by the broadest side, in order that the strokes may accompany more softly the lines which design them, and leave the leanness of the outlines, which form the leaves, less visible. Earth may be engraved by little strokes, short, and very lozenge, that the cracks of their angles may render them coarse, and formed by all sorts of free work, which is very suitable to them.

Blunt needles are more proper for engraving architecture than those that are more cutting, because these

last entangle themselves in the copper, and do not leave the hand the freedom of guiding them every way, as it is necessary they should, especially in the engraving trees. Architecture is commonly engraved square and regularly. When, nevertheless, it is only secondary, as in a subject of history, in which case it is made subserviently to the figures, it is much better to engrave it with the hand, that it may not have a neatness which may rival the figures. The strokes must be also a little waving; but ever with order; because, in general, things that are engraven, even those which are least capable of neatness, ought always to be done with equality and arrangement, provided it may be without affectation, that there may be no lines which may run into each other, and break the keeping of the masses, by spots of too strong black. For effect can be made only by great masses united, whether of shade or of light, relieved, nevertheless, by some touches in the places indicated in the original, which ought to be strictly followed. Engraving is at best only too repugnant to that keeping which ought to reign in the masses, by the little white interstices that are left in the squares, without yet adding those strong spots and holes of black, by the irregularity of the strokes; and it is frequently necessary even to close up, as it were, all those squares with points, to be able to make a dead tone or cast. It results from what we have here laid down, that the engraving in great, where many things are left to be retouched by the graver, ought to be prepared with much taste and neatness; also that it must be avoided to use too much force in the touches and outlines, for fear, when they come to be corroded with the rest, there may be a necessity of taking off the *aqua fortis* before it has been suffered to corrode the shade to an advantageous tone; or rather, that the *aqua fortis* having hollowed them too much, it may make it requisite to foul the work to accompany and correspond with them, or perhaps even after all, to efface them entirely. It is much better to be obliged to strengthen them with the graver, especially, as whatever pains may be taken to hit the point, it may prove, nevertheless, when the *aqua fortis* has had its effect, that there will be occasion to re-

touch them; and as, moreover, they will never be found to have that perfect exactness which it had been hoped to have given them. For this reason, it is proper that the touches and outlines should be corroded in such manner that they may be gone over again easily, either on the inside or outside, without effacing any thing.

Engraving in small should be treated differently from engraving in large; as the principal merit of it consists in being designed and touched with much spirit; the sketch should be drawn with more force and boldness, and the work which is added should be done with a freer, and, as it were, more sportive needle. The touches which take away the ease in designs at large, are the whole life of those in little, in preserving always the masses of light tender and large. All this excellence depends on the *aqua fortis*, and the graver ought to add to it nothing but stronger masses, and some sweetenings. As the graver is an instrument that works stiffly, and with coldness, it is very difficult not to diminish, or even not to destroy, that spirit and lightness the needle of an engraver well versed in design has given to the work; for which reason it should be used with great discretion, and only to give a little more effect and keeping.

The *aqua fortis*, therefore, must go nearer the finishing the design, and corrode more in small works than in great, as even from the sketch which may be made with it, there appears enough done for the taste of men of judgment; and the graver should only be employed to render it more agreeable in the eyes of the public, of whom the far greatest part are not enough conversant in design, to be any way sensible of the effect of spirit. This was not unknown to the celebrated Mr. Picart, whose first designs, though less charged with work than the others, shewed yet enough of it; but seduced by the applauses of the multitude, he gave himself up at last to a heavy and laboured manner; and not content to take away all the merits of his heads, by working with little needles, he loaded his draperies with hard and inelegant strokes, and even pushed his extreme passion for high finishing to such an excess, as to attempt to express the different colours of clothes; which, in

small, was attended with the destruction of all the taste and spirit of the performance. His productions, so long admired by the vulgar, (though on other accounts valuable by the elegance and extensiveness of his genius) were for this reason never comparable to those in which are found the pleasing negligence of *La Belle*, the sprightly touch of *Le Clerc*, or the sportive and picturesque point of *Gillot*.

Where a work, greatly advanced towards the finishing with *aqua fortis*, is desired to be given with spirit, the needles ought to be often changed on the foreground; and, to give more character to things that are susceptible of it, they must be engraved by strokes short, detached, and drawn firmly along the muscles, or draperies, of which they form a part; for the long and united strokes give a finishing that is cold and without taste. The closer the strokes are brought, the more the engraving appears valuable, provided that it be done judiciously, in observing the degradation of objects on the foreground with those that are more distant, and of things that are detached from what serves them as a ground. It is for this reason engravings are made with fine and close strokes, to produce a work that may be liked; or, at least, that may be conformable to the taste of the present age; where, in general, they esteem engravings in small, only in proportion as they appear to be made with fine strokes, as if merit consisted only in having good eyes and much patience.

The outlines should be designed in a manner a little square; they ought not to be obscure, but distinctly visible. Much pains is now taken to form them only by strokes, which approach to the place of them. This manner may, perhaps, be good in larger works; but it is very faulty in small, because it gives too much softness to the outlines. It may be justly repeated and maintained, in spite of the vogue and the bad taste now prevailing, that engravings in small ought to partake of the nature of a sketch, and that the more they are finished, the more they are robbed of their principal merit, which consists in spirit and the boldness of the touch. There ought to be only few points or dots used in finishing the flesh. Some works, in small, are to be found,

that have otherwise value, but in which the flesh is loaded with points so near each other, that the lights appear as shining as bronze, which occasions the draperies that are worked in a different manner to appear too much neglected. Nothing but motives of interest, and the desire of pleasing men who have no knowledge of design, could be inducements to pursue so bad a manner, since every thing may be as well done with much less labour; and in the arts which relate to design, the merit of all work is in proportion to its appearing executed with ease and simplicity. In engraving in small, it should be avoided, likewise, to give too much attention to delineating all the particular parts of the head, as in great. Some little strokes, touched as a master, form pretty heads, and even expresses the passions better than all the pains that can be bestowed, to mark the ball of the eye, the eye-lids, the nostrils, and other minuter parts. It is true that this draws more admiration from the multitude, or from those learned persons whose proficiency in other sciences makes their decisions be considered as of importance in an art which they do not in the least understand. But this extreme high-finishing is only a slavery, from which an able artist ought to free himself, and which is advantageous only to men of moderate talents, and who have not abilities to succeed with less expence. Figures, ground, and other things, which ought to appear at a great distance, are engraven almost entirely with the same needle, except the most tender parts. The needle should not cut too much, for fear the touches may make holes, or sharpnesses, which destroy all the effect in small, and are extremely difficult to be taken out; because, in order to do that, it is necessary to efface all the parts round them, which can never be so well replaced by the graver.

When the flesh is finished by the graver, it is difficult to make use, with success, of such needles as are long pointed, and yet more of such as are extremely short, otherwise they would make a flesh that would seem covered with skin. Scarcely any thing but needles, rounded at the point, should be employed in preparing the plate with the *aqua fortis*, except that in the shades of the flesh, the engraving may be made with a stroke or

two by those which have long points. Something may also be hazarded, as to the strokes of the third order, in the things which ought to be much compounded, as clouds, ground, and other places, that are considered of no importance, but to serve as back-grounds for other objects. But they should be engraved with a very small needle, with the intention that they may be less corroded than the others. In short, this should be so managed that the plate may be entirely finished with the *aqua fortis*, if possible, in order to preserve all the spirit of the design; for the more the work of the *aqua fortis* is put into it, the more certain it will be of succeeding, provided it is done judiciously and with taste, and that it is not suffered to be too much corroded. This is the way to please able men and true connoisseurs, whose approbation is gratifying, and desirable to such as aim at perfection, and to acquire a solid reputation.

S E C T. XIII.

Of the Preparation and Composition of Aqua Fortis proper for each kind of Engraving.

THE *aqua fortis*, used for the soft varnish, is spirit of nitre, such as is used by the refiners, and which may be best prepared in the following manner:

“ Take of crude nitre, (commonly called rough
 “ petre) the white kind, or of refined salt-petre, twenty-four pounds. Put it into a retort, of which it will
 “ fill about two-thirds, and add to it twelve pounds of
 “ oil of vitriol. Place the retort in a strong sand-heat,
 “ where it may be as low as the proper turn of the
 “ neck will admit, and lute on to the retort a very
 “ large receiver, containing about a gallon of water.
 “ Distil over all that will rise, first with a gentle heat,
 “ and then with a stronger, as the quantity arising may
 “ shew to be necessary, taking care that the receiver be
 “ not violently heated. When the whole is cold, take
 “ off the receiver, and pour the *aqua fortis* into a bottle,
 “ where it may be perfectly well secured by a glass

"stopper. It is indifferent whether crude nitre or salt
 "petre be used, except with regard to expence, the
 "first being much cheaper than the other."

This is the spirit of nitre, such as is used by the re-
 finers, (except that it is not putrified with silver, as is
 practised by them, which is unnecessary for this pur-
 pose) and is the kind commonly employed for engrav-
 ing. But it requires, before it be applied in that inten-
 tion, to be lowered by the addition of half its weight,
 or more, of water. It may, however, be greatly im-
 proved for this purpose, by compounding it with oil of
 vitriol, in the proportion of one part of the oil of vitriol
 to nine or ten of the spirit of nitre, which makes an
aqua fortis that will consume the copper more keenly
 and cleanly than a purer spirit of nitre, without leaving
 any roughness or frosted appearance in the lines, which
 is sometimes found where the *aqua fortis* does not well
 perform its office. Where this composition of oil and
 vitriol and spirit of nitre is used, it is proper, however,
 to augment the proportion of water, which, instead of
 being as two parts to one, may be as five to two, or it
 may be too active for the purpose.

The *aqua fortis* for the hard varnish, according to Le
 Bosse, may be thus prepared: "Take three pints of
 "vinegar, six ounces of *sul ammoniacus*, the same quan-
 "tity of common salt, and four ounces of verdigrise,
 "or in proportion according to the quantity of *aqua*
 "*fortis* that is wanted. Pound the solid ingredients
 "very small, and put the whole together into a var-
 "nished earthen pot, of a size larger than will contain
 "them, that there may be room for them to boil with-
 "out overflowing. Cover the pot with its lid, and
 "then place it on a strong fire, and make the whole,
 "as quickly as possible, boil up two or three times, and
 "no more. When the matter appears ready to boil,
 "but not sooner, uncover the pot, and stir the whole
 "together from time to time with a small stick, taking
 "care, when the ebullition rises strongly, that the *aqua*
 "*fortis* do not boil over; for which reason the pot is
 "advised to be large, because, commonly, when the
 "mixture begins to boil, it swells and rises greatly.
 "Having boiled up three times, the pot must be taken

“ from the fire, and the *aqua fortis* left to cool in it;
 “ and being cold, it must be poured into a bottle of
 “ glass or stone ware, keeping it a day or two before
 “ it be used. If in making use of it, it be found too
 “ strong, and that it turns the hatches into paste by so
 “ scaling the varnish, nothing more is required than to
 “ moderate it, by mixing a glass or two of the same
 “ vinegar of which it was made.” So far Mr. Le
 Bosse.

Distilled vinegar has been recommended as being very excellent for making this *aqua fortis*, and is said not to be so apt to make the varnish scale. But I see no reason for this preference, because the common vinegar is stronger than the distilled, and will produce a more perfect incorporation of the ingredients; and if the effect of scaling the varnish result, it can be only from the *aqua fortis* being too strong, which may be easily remedied by the addition of a small quantity of water, if Mr. Le Bosse's experiments of putting more vinegar does not answer the end. The water, in this case, will not produce the least inconvenience, as it will incorporate with the mixture, without making the least change in, or separation of, any of the ingredients, except by rendering the activity of the whole less.

This composition is not, properly speaking, *aqua fortis*, but called so, in this particular application, from performing the office of the true *aqua fortis*, which is a composition of the acid spirits of nitre and vitriol, without any metallic or saline substance; whereas this mixture does not contain a drop of either, but is composed, besides the vinegar, of copper, *sal ammoniacus*, and common salt; ingredients of a very foreign nature to those which constitute the true.

Mr. Cochin observes, that this kind of *aqua fortis*, though deemed to belong to the hard varnish, is nevertheless, excellent also when used on the soft; and he asserts, if any will make trial of it, they will find it much better than that of the refiners; and further, that it is not so subject to make the varnish scale, nor to several other disadvantageous accidents; as for example, the being prejudicial to the sight and health.

S E C T. XIV.

Of the mixture of Tallow and Oil for covering the Plates, to secure them from further corrosion, when necessary.

THE mixture for securing the plates from further corrosion is, according to Mr. Le Bosse, thus made:

Take an earthen-ware pot varnished, of a greater or less size, in proportion to the mixture that is to be made, and put into it some olive oil, and place it on the fire. When the oil is hot, throw into it the tallow of a candle, which being melted, some of the mixture must be taken out with a pencil, and dropt upon any thing hard and cold; as, for example, on a plate of copper. If the drops are found moderately fixt and firm, it is a proof that the proportion of tallow and oil is well adapted; but if it be too liquid, the obvious remedy is the adding more tallow; and, on the contrary, if it be too stiff, more oil must be put to it. Having accommodated the mixture properly, it should be very well boiled for the space of an hour, in order that the tallow and oil may be well mixt and incorporated together; the boiling may be continued till the mixture become red, or approaching to it, as otherwise the ingredients are apt to separate when they are used."

The reason why oil is mixt with the tallow, is only to render it more liquid, and to prevent its setting so soon; for it is evident that if tallow was melted alone, it would be no sooner taken up by the pencil than it would grow hard, and set before it was brought to the necessary place of its application.

More oil should be put to the tallow in winter than in summer.

Mr. Cochin observes, that the use of the mixture of oil and tallow, which is generally employed for covering the plates in the places where the *aqua fortis* is to be prevented from corroding further, requires much care and application in taking the *aqua fortis* so often from

off the plate, and in washing and drying at the fire, which demand a considerable space of time, and delay the proceeding with the corrosion. He therefore proposes a new mixture, which has this advantage, that it may be put, with the end of the finger, in the places where there is occasion for it, without taking off the *aqua fortis*, but while even it is acting on the plate. This mixture is as follows:

“ Take equal parts of wax and turpentine, as much
 “ olive oil as both of them together, with the same
 “ quantity of hog’s lard: Melt the whole over the fire
 “ in an earthen vessel, taking care to mix the ingredi-
 “ ents well, and leave them to boil some time, till they
 “ be well incorporated together.”

The advantage of this mixture is, that it may at any time, being warmed, be put with the finger on the places desired to be covered; by which means, the further operation of the *aqua fortis* on such places, may be instantly prevented, without any other trouble or preparation, or without interrupting or delaying the principal operation.

This mixture may be employed equally well with the hard as with the soft varnish; as the intension of using such a composition, and the manner of applying it, which will be explained in its proper place, are the same in both cases.

SECT. XV.

Of the method of putting the Plate in a proper state to receive the Aqua Fortis, and of pouring it on the Plate; with the manner of applying the Compositions for preventing the Sweetenings, Lights, &c. from being corroded beyond the due degree.

THE method formerly used for this purpose, and given by Mr. Le Bosse, is as follows:

The plate being properly engraven, and ready to undergo the operation of the *aqua fortis*, the composition of tallow and oil, given in p. 119, must be warmed till it be melted: then, with a larger or smaller pencil,

according to the size of the places that are to be covered, it must be applied upon all those parts which it is desired the *aqua fortis* should not act upon; and, to answer this purpose effectually, it should be laid on pretty thick.

This being done with a hog's hair brush, or other such instrument dipt in the mixture, the reverse, or back of the plate, should be rubbed over; as also the edge, in order that they may not be corroded by the *aqua fortis*. The failing in this would not indeed be so injurious to the plate as to the *aqua fortis* itself, with regard to its further use. But great care should be taken that the mixture be not too fluid; for if it be so when the *aqua fortis* is poured on the plate, it will make it move, and leave the place where it was at first put. For this reason the mixture should be, as I have said, proportioned, as to the quantities of the ingredients, in such manner that, as soon as it is laid on, it should set to a firm consistence.

Mr. Le Boffe says, that it was his usual practice to put, from time to time, a little of the mixture on his left hand; especially in winter; that, holding it there, it might be kept half melted by the heat of his hand; which is a much more convenient way than to have occasion to melt it continually in the vessel that contains it. He says also, that it has several times occurred to him, but more particularly in using the soft varnish, that the *aqua fortis* has carried it all off the plate in a moment. Having endeavoured to discover the cause of this accident, he once found, in raising the plate from the table, after having worked on a very cold day, that it was all wet on the back, which made him imagine some moisture might probably have got betwixt the varnish and the copper. This induced him to make a trial of the matter, by working on two plates, varnished both in the same manner; of which he held one to the fire, to dissipate the moisture before he put the *aqua fortis* upon it, which succeeded very well; but the other, which was not so treated, miscarried by the separation of the varnish from the copper, as he had concluded it would. For this reason it is necessary, especially in winter, to hold the plates to the fire, to dry them tho-

roughly before they undergo the corrosion; and more particularly, when the strong *aqua fortis* is to be used, it being a matter of great importance to the success of the work. There is another thing he likewise advised to provide against, though it does but seldom happen. It is, that the copper is sometimes (as it were) fat in its nature in spots, which prevents the varnish from taking hold of it, although it seems to adhere properly; and the copper therefore cannot properly be distinguished to be thus faulty till the *aqua fortis* be put on. For, if the *aqua fortis* be poured seven or eight times on these fat places, when they are engraved upon, the colour of the copper appears more red there than in other parts where it is not fat, and the varnish is very subject to peel off from them. There is no remedy against this, when matters are gone so far, but to finish the plate with the other kind of *aqua fortis* made with good vinegar.

When the plate is thus prepared, by covering the proper parts of it with the mixture of tallow and oil, it should be laid on the board or frame described in p. 75, and placed against a wall, or some other body which may keep it firm in a sloping posture. The trough described there also, should then be set at the foot of the board; and the earthen pot, or other vessel to receive the *aqua fortis* as it runs off, placed under the trough; but it must be raised as near it as possible, that the stream of the *aqua fortis* falling out of the trough may not make a spray. For, that rising over the sides of the pot, would waste the *aqua fortis*, or make such a foam in the pot, as would be inconvenient when it comes to be poured again over the plate.

The whole being thus fixt, a proper quantity of the *aqua fortis* must be put in an earthen pot, or other proper vessel; and, by means of a lesser vessel, convenient for lading it out of the other, it must be poured on the plate, at the upper end, in such manner that flowing down every part of the plate, it may be equally covered, taking care not to touch the varnish with the pot. The *aqua fortis* running down the plate will be collected in the trough, and then fall into the vessel placed underneath to receive it; from whence it must be returned

seven or eight times on the plate, proceeding as in the first. The plate must be afterwards turned, so that the other end may be uppermost, and the *aqua fortis* again poured ten or twelve times over in the like manner as before. The same must be done by the two sides, the operation being continued, still turning the plate, after eight or ten pourings on for the space of half a quarter of an hour, or more or less, according to the force of the *aqua fortis*, or the readiness of the copper to suffer the corrosion; for if the copper be short or brittle, the *aqua fortis* must be poured a less time; and if it be ductile, it may remain a longer. As it is not easy to know certainly the strength of the *aqua fortis*, nor the peculiar quality of the copper, the following method is given for regulating the matter according to the force and the due corrosion that is intended to be made upon the plate; for in some instances the plates require a much stronger, and in others a much gentler effect of the corrosive action. The method is, to pour the *aqua fortis*, in the manner just directed, for the first time half a quarter of an hour, and then to take away the plate, and to pour water on it copiously, from a vessel raised to some distance above it, to wash it till it is entirely freed from the *aqua fortis*; for, if it be not well washed, when it is dried the varnish will appear green, and hinder the work from being distinctly seen. Afterwards the plate must be put before a clear fire, in such manner that, without melting the mixture of oil and tallow which may be upon it, the fire may dry away the water. This being done, the varnish must be rubbed with a little piece of coal in some place where there are fine strokes or hatches. If it be found that the *aqua fortis* has corroded the sweetenings sufficiently, some of the mixture of oil and tallow must be melted; and the plate being put on a painter's easel, or other such convenient thing, the distances and other places, where the hatches are desired to be tender and soft, should be covered with the mixture by means of a pencil, as if it was to be painted with it. This should be done as well on the part that has been rubbed with the coal as the others, where a further corrosion is improper, remembering that the mixture should be always spread thick enough on

the places that are wanted to be covered with it ; as it is not sufficient that the pencil should be only greasy, to rub over the hatches, but it should be well charged with the mixture, and cover the places with it as if they were painted. Regard too must be had that it should be particularly done in this manner, the first time the tender and soft hatches or strokes are covered. After having (if it be in winter) set the plate before the fire to dry away all moisture, it should be put again on the board, and the *aqua fortis* thrown over it as before, for the space of about half an hour, turning the plate every way from time to time. The plate should be then washed with common water, and dried at the fire, as the first time, without melting the mixture of oil and tallow, which should be carefully avoided, or otherwise the work runs the hazard of being spoilt.

The plate being then dry, it should be put again upon the easel, and the hatches and distances, which are next in force to the weakest, covered with the melted mixture of oil and tallow in the same manner as the others were before. But it may happen, that in drying the plate by the fire after it has been washed, the mixture of oil and tallow may by accident be melted, and run into the hatches that are required to be still more corroded by the *aqua fortis*. In such case the places should be wiped with a soft linen cloth, and then well rubbed with a crumb of very stale bread, till such time as it may be concluded the grease is entirely taken off, that the *aqua fortis* may not be prevented from operating properly, which is a reason why the utmost care should be taken this accident may never occur at all.

In order to proceed with the corroding the plate that is thus covered once more in the proper parts with the mixture, it must be again put upon the board, and the *aqua fortis* poured upon it for half an hour. This being done, it should be washed with clean water and dried, as in the other cases, and then covered, for the last time, in the places remaining necessary. For it is obvious, that according to the nature of different designs, and the work with which they are executed, there are more or less softenings and sweetenings to be made. After this last covering, the *aqua fortis* must be again poured

over it as before, but for a longer continuance, which must be regulated by the occasion; for neither at this last time, nor after the covering the distances and sweetenings, can any precise rule be given; and the means of judging occasionally can only lie in experience, and making repeated examinations during the operation, by laying proper parts of the plate bare in the manner above advised, to see the effects of the *aqua fortis* from time to time.

The corrosion having been thus continued for a sufficient time, which in many cases will be about an hour, the plate must be again washed with common water; but it is not necessary to dry it as before, even if it was intended to pour yet more *aqua fortis* upon it; and nothing more is required than to let it wet as it is over the fire, till the mixture of oil and tallow put upon it be entirely melted; and then wipe it thoroughly clean with a linen cloth, both on the right and wrong sides, till the mixture be entirely taken off from every part.

Mr. Cochin mentions a method used by Mr. Le Clerc, for flooding the plate with the *aqua fortis*, more simple and easy than his own we have been giving, which is this: He had a tray or chest of a convenient size, of which the sides were about three or four inches in height, and of very thin wood well joined together, and calked on the outside with rolls of paper. This tray was painted with oil as well within as without, that it might hold the *aqua fortis*, without imbibing any of it. When the corrosion was to be made, the plate was greased on the under side, and being placed in the bottom of this tray, the *aqua fortis* was poured into it till it rose to the height of a line or two. The tray was then shaken with a soft and gentle motion, to make the *aqua fortis* pass and repass over the plate. This was done by taking the tray on the knee; or if the plate was large, by placing it in equilibrio on a round thick stick put upon a table, by either of which means it could be raised by a slight motion, first at one end and then at the other, to make the *aqua fortis* flow over the plate as often as was desired; or, instead of a stick, he used any thing else that could answer the purpose, and was most easily procured.

If the plate was warped, and would not lie flat on the bottom of the tray, but suffered the *aqua fortis* to pass under it, he fastened it down with pins or small nails till it lay level; and if it was large and heavy, he put others to hinder it from stirring or gliding out of its place, taking care always to grease well the pins or nails that were employed for this purpose.

When the plate was taken out to wash it, in order that any thing necessary might be done, it was held declining over a sink, and water was poured gently over it several times. For experience has shewn, that being suffered to fall upon it from a higher distance, as Mr. Le Bosse advised, was frequently injurious, as it often crackt the varnish, and rendered it incapable of resisting afterwards the *aqua fortis* for any length of time, without separating from it before the plate was sufficiently corroded. The plate being thus washed, he let it drain a short time, and then having placed it on a table, a sheet of foul paper, or some print that had miscarried, was spread over it, and pressed gently upon it with a handkerchief. This paper was then lifted off carefully, and another put in its place, which entirely sucked up all the water remaining on the plate that had been left by the first; and after this he held the plate a moment or two to a slow fire to take away any, even the least damp that might be left on it. In the case of the soft varnish and the refiners' *aqua fortis*, Mr. Cochin recommends the following method to be pursued for managing the plate, pouring on the *aqua fortis*, and spreading the defensive mixture over the proper parts.

Take soft sealing-wax, such as is used for putting seals of office to writs, grants, &c. (whether it be coloured or not is immaterial) and soften it at a fire if it be used in winter; but in summer it may be made sufficiently soft and pliable by working it with the hand. Having thus prepared the wax, lay the plate on a table, or any other flat surface where it may be duly level, and raise upon the edge of it, where there is nothing engraved, a small border of the wax, of about an inch high, in the resemblance of a little wall or rampart, and carry it round the plate in such manner, that the *aqua fortis* being poured within, it may be detained upon the

plate, and prevented from spreading or running off at any part. In winter it is proper to heat some of the wax to apply along the joints of the plate and this border, in order to render them more tight and impervious to the *aqua fortis*. But let it be remembered, before this border be put round the plate, to dry it well at the fire, to prevent any water being harboured betwixt the varnish and the copper, for the reasons above given, which are particularly cogent with respect to the soft varnish.

At one of the corners of this border a gutter is usually made, which serves for pouring commodiously the *aqua fortis* over the plate; and the sides of this gutter are to be made higher than the rest of the border, in order that in declining the plate to pour off the *aqua fortis* into the vessel designed to receive it, it may not run over the border. There are some who cover the sides of the plate where the wax is fixt with the mixture of oil and tallow, to stop any little holes through which the *aqua fortis* might escape under the wax; but this method is injudicious, and fouls the hands when the wax is to be handled, in order to the taking it off to serve for another time; for which reason it is much better to fix the wax to the copper when it is well softened, and render it adhesive by the fire; and while it is yet ductile, to run the finger along the joint that the wax makes with the copper, by which means it may be closed in the most perfect manner.

The plate being thus bordered, take a due quantity of the refiners' *aqua fortis*, pure and good, and mix it with half (or more) of its quantity of common water; or where there is *aqua fortis* that has been used before, (which may be easily distinguished by its blue colour) it may be employed in the place of common water for mixing with the fresh; in which case allowance must be made for the strength.

Of the *aqua fortis* thus prepared, pour gently then through the trough or gutter made at the corner of the border of wax put round the plate, as much as will rise a finger's breadth above the plate. Then if all things have been rightly conducted, it will be seen that the *aqua fortis* will quickly exert its action in the hatches

which have been strongly touched, but those more weakly engraved will appear at first clear, and of the colour of the copper, because it has not soon any operation on them that is very perceivable by the eye.

When it has appeared that the *aqua fortis* has for some time acted with vigour on the strong touches, and that it begins to take effect on the tenderer parts, it should be suffered to corrode only a very little more; and it may be easily examined if the *aqua fortis* has done its office, by laying bare a proper part by a piece of coal, in the manner before mentioned. The *aqua fortis* should be then poured into a vessel of stone ware; and water should be immediately put upon the plate, to take off or weaken any that may remain on the plate in the engraved parts, and then the plate should be dried in the way before advised. The plate being again in this state, take some of the mixture of the oil and tallow, described p. 119, and cover the lights, &c. as Mr. Le Bosse has advised in works of less consequence. And where despatch is wanted, it is better to take some of the other composition of wax, turpentine, &c. and having melted it, to lay it on with the end of the finger, or by means of a pencil, over the parts to be covered, which may be done without washing, or any other preparation than pouring the *aqua fortis* off the plate.

The proper places being covered by either of these methods or compositions, the *aqua fortis* must be again put on it, and left there for the space of half an hour, or a longer or shorter time, according to its strength, or the nature of the work; and then it must be taken off as before, and water immediately thrown on the plate.

It is proper to observe that, when the *aqua fortis* is on the plate the feathered part of a quill should be used, to cleanse away the foulness or verdigrise that gathers in the hatches when the *aqua fortis* operates on them, and to give a freer room to exercise its action, as also to be able to perceive it, if the varnish should crack, which the ebullition of the *aqua fortis* otherwise hinders from being seen. This is done by moving the *aqua fortis* to and fro on the plate by the feathered part of the quill,

and brushing away the black saline matter where it appears to be formed.

The sealing-wax above mentioned by Mr. Cochin, and of which he has omitted to give the preparation, being most probably ignorant of it, may be best made by the directions given in p. 26, for the yellow kind of soft wax; and it may be rendered harder or softer in the original composition, according as the season or the occasion may make expedient, by diminishing or increasing the proportion of resin.

The practice of using the same *aqua fortis* over again in the place of water, is certainly a bad one; as, being replete with the verdigrise or salts of the copper, it cannot fail to fill the hatches much sooner with foulness of that kind, when the fresh *aqua fortis* acts along with it, than when water is used. From whence it is evident, as this is attended with the inconvenience mentioned by Mr. Cochin, of obstructing the operation, and preventing the effect from being visible, that it is better to use water only for diluting the *aqua fortis*.

The *aqua fortis*, formed by adding oil of vitriol to spirit of nitre, of which the preparation is given in p. 117, and which is much the best of any of that kind for engraving, requires to have more than half its weight of water added, as well because it is stronger of itself than that which is to be met with in shops, as on account of the greater activity it receives from the addition of the oil of vitriol.

S E C T. XVI.

Of the manner of taking the Varnish off the Plate, when the corrosion by the Aqua Fortis is finished.

WHEN the soft varnish is to be taken off, after the finishing the corrosion, the plate must be first warmed at the fire, and the border of wax round it removed away: Then it must be made hotter till the mixture or composition, as well as the varnish melt, when it must be well wiped with a clean linen cloth, af-

terwards rubbed heartily in every part with oil of olives; which being performed, it is ready to be retouched by the graver, if there be occasion.

The manner of taking off the hard varnish, according to Mr. Le Bosse, is as follows:

Choose a very soft coal of fallow wood, and, without burning it, strip off the bark, and then dipping it in water, of which some likewise should be poured on the plate, rub the varnish with it, but continually the same way as in polishing the copper, which will take off the varnish. Be particularly careful, nevertheless, to prevent any gravel from falling on the plate; as also to observe that there be no hard grains in the coal, for either of these would make scratches on the plate, which would be very difficult to be effaced, especially upon the tender parts and sweetenings. This is a reason why the coal used for polishing should not be applied to this purpose, as it would injure the tender parts, by wearing them away in some degree; and the coal which is not burnt a second time does not take upon the copper, or but in a very slight degree.

When the varnish is all taken off from the plate, the copper remains of a disagreeable colour, from the effect the fire and water have had put upon it; but, in order to restore it to its usual appearance, use this method: Take of the refiners' *aqua fortis*, and, if it be pure, put two-thirds, or more, of water to it. Then take a linen rag dipt in the *aqua fortis* thus lowered with water, and rub with it all the engraved parts of the copper, by which it will be soon found to become bright and clean, and of the common colour of copper.

Wipe the plate immediately after this with another linen rag that is dry and clean, till not the least of the *aqua fortis* and water remain on it, and pour upon it afterwards a little olive oil, and with a small piece of old hat, or other such thing, rub the oil strongly over every part of it. After this, clean the plate with a linen cloth, being cautious not to employ the rag for that purpose, which had been before used to wipe off the refiners' *aqua fortis*.

It may then be seen fairly whether there be occasion or not to retouch the plate with the graver, as it fre-

quently happens there is a necessity for doing, especially in the places which ought to be very brown; for it is easily conceivable, that when there is many hatches one upon another, there scarcely remains any varnish betwixt them; and, consequently, it often happens, that the *aqua fortis* takes away what little substance there is, and, by corroding under it, reduces the whole to a paste or shell. If, however, it should at any time be found that this accident had occurred in corroding with the *aqua fortis*, the place which is flawed should be immediately covered with the mixture of oil and tallow, or wax and turpentine. It is much more easy, when this is done, to repair the defective part with the graver, than when the *aqua fortis* has made a hollow, that in printing at first produces a black spot, and after some few impressions a white one, because the printing ink will not any longer stick to it. If the injured part be thus covered in good time, nothing more remains necessary than to repair, with the graver, the strokes and hatches, to strengthen them by the method taught in the first chapter, where the manner of engraving with the tool is treated of.

S E C T. XVII.

Of the method of Re-engraving, by means of Aqua Fortis, what may have been at first forgotten, or may be desired to be added after the Plate has undergone the operation of the Aqua Fortis.

IT frequently happens that something has been designed in the engraving on the varnish that does not afterwards give satisfaction, and has therefore been covered with the mixture of oil and tallow during the corrosion, in order that the *aqua fortis* may have no effect upon it; or even after the finishing the work as first designed, it may be desired to add some additional part, as in the instance of draperies, and on many other occasions that occur. In any such case, the plate must be rubbed well with olive oil on the engraved places, that the printing ink, or foulness of whatever kind, which

may be in any of the hatches, may be taken out, and then the whole must be freed from the greasiness of the oil by the crumb of stale bread, till not the least, either of greasiness or dirt, may remain on the surface, or in the hatches.

Heat then the plate over a charcoal fire; and, having put the soft varnish upon it, spread it with the ball of taffety filled with cotton, as has been above directed. The greatest object of care in doing so is, that the hatches which are intended to remain may be filled with varnish. This being done, blacken the varnish in the manner above described, and then engrave whatever omission or addition may be judged proper. Corrode then the plate the same way as before, taking care, before the *aqua fortis* be put on, to cover what may be necessary with the mixture of oil and tallow, in the manner directed for the former corrosion, as likewise all the first engraving. This is very necessary for fear the varnish might not secure every part from the *aqua fortis*, and that the whole may be rendered more safe by this means; as, if there should be any hatches that might happen to be neither covered with the varnish nor mixture, the *aqua fortis* would certainly get into them and spoil the plate. Having finished the corrosion, the varnish must be taken off the plate, by means of heat, in the manner before directed in the case of the soft kind.

CHAP. V.

Of scraping Mezzotintos, and the applying that art to the production of Coloured Prints resembling Pictures.

S E C T. I.

Of the general Nature of Scraping Mezzotintos.

THE scraping mezzotintos is a kind of engraving which is executed by covering the surface of a copperplate with lines, sunk in it close to each other, in different directions, so that it would, if used for printing in this state, give a black impression, or ground, from the whole; and then taking away or diminishing the effect of the ground, by scraping or burnishing, according to the necessary expression of any given design, such parts of these lines as brings the plate to the same condition, as if lines had been originally cut, correspondently to the manner of other engravings, in those places where they were wanted to express the shades or darker parts of the design.

This appears, therefore, in one view, to be an opposite kind of engraving to the others, as in them the shades and darker parts are formed by the destroying part of the lights, of which the whole ground must be considered as at first consisting; whereas in this the ground being originally all shade, the lights are produced by destroying parts of it. As it is much easier to scrape or burnish away parts of a dark ground correspondently with the outline of any design sketched upon

it, than to form shades upon a light ground, by an infinite number of hatches, strokes, and points, which must all terminate with exactness on the outline, as well as differ in their force and manner, the method of scraping in mezzotinto consequently becomes much more easy and expeditious than any other method of engraving. For which reason it is of course much better accommodated to painters, or others, who are masters of the design, and desirous to engrave prints without the long application to attain the talent, and the labour and trouble afterwards required to exercise it, that attend the other methods. The forming the ground of the plate, which is part of the necessary work, is indeed laborious and tedious. But it may be thrown upon those who are used to such mechanical employments, as it requires little skill or judgment, unless what may be acquired by a small share of practice, being a matter only of care and application, and therefore no proper part of the business of the artist who is to scrape the design on the plate. There is, moreover, no doubt but that the ground of mezzotintos may be made by proper machines with much greater ease and accuracy than by the hand, as at present. The invention of a machine for this purpose would be a very high improvement of this art, and probably afford both honour and profit to the person who should bring it to perfection. Not only the facility of the work, but the effect of it when finely executed, are great recommendations to this kind of engraving, as the extreme softness of the tints, along with a great force of relief, renders the prints done this way, that are perfect, more generally pleasing than those engraved in any other manner, which the great number of portraits lately done evinces.

It is, however, only with regard to some kind of subjects that this species of engraving has this merit: portraiture is the great object of its excellence; and some landscapes have been done that are not contemptible. Horses also have been attempted with success; and some designs of history, properly adapted, may be brought within its reach. But, where any thing besides the portraits of men, and other animals, come in question, there must be a peculiar accommodation of the subject

as its powers, with respect to variety of expression, are much less extensive than those of etching, and consequently fall far short of those of the graver. The principles on which the fitness or unfitness of subjects for this kind of engraving are founded, are of two kinds; the one respecting the proportion of light and shade; the other the nature of the design with regard to the outline. Such pieces as contain large and clear masses of light do not succeed at all; but where, on the contrary, there is a large proportion of very dark parts, as in the representations of night scenes, or a large proportion of brown shades, as in the pictures of Rembrant, Benedetto, and Teniers, in some instances, the best effect is produced, and with the least labour. Such pieces, likewise, as are of a simpler composition, and do not require great force and variety of expression, as passion and character, are suitable. But where great spirit and freedom are required to give merit, this manner of engraving fails, as it does not admit of those sharp and delicate strokes and touches which are the means of that expression.

SECT. II.

Of the Instruments used in scraping Mezzotintos, and preparing the Ground.

THE instruments employed in scraping mezzotintos, and the preparation of the plate, are *cradles* of two sizes, the one for making, and the other for repairing the ground; *scrapers*, and *burnishers*.

The cradle is a tool formed of steel, resembling, in its general shape, a chisel, with one sloping side, upon which are cut hollow lines very close to each other, but at distances as exactly equal as possible. The part of this instrument, which is to act on the copper, is made of a circular form, in order that it may be moved on the copper without catching; and the corners are also considerably rounded, otherwise they would mark more strongly than in the middle, and make some spots or places more black than the rest. When this instrument

thus formed, it is tempered in the manner practised by those who prepare other edged tools, where great hardness is required (for which a method is before laid down in treating of the instruments for engraving, p. 49.) This being done, it must be sharpened on the whetstone; when particular regard must be had to the proper rounding of the corners, if it be not done before. No lines are cut on the flat side, but the extremity of it being whetted to a very small slope gives a very sharp edge to the little teeth formed by the hatches or lines on the other side.

The lesser cradle for repairing the ground, where any part having miscarried there is occasion to restore it, is the same with the other, but less; and indeed there should be some of several sizes, as the spots of the ground to be repaired may vary greatly on different occasions.

The scrapers are formed much in the manner of a knife, except that the edge is straight till near the point, and there slopes off at an angle from both sides; the lines of which slopes meeting, form another angle of the print; but the slope on one side is made longer than that of the other.

The graving tool is a steel instrument, formed like a square pyramid, ending in a sharp point.

The burnishers are the same as are used in the other kinds of engraving, but less, in order that they may efface more effectually whatever may require it, and that they may make straight strokes of light, without touching what may lie contiguous on either side.

The graving tools and burnishers are frequently made in one piece; the one being at one end, and the other at the opposite.

S E C T. III.

Of the manner of forming the Ground on the Plate, in order to the scraping in Mezzotinto.

THE plate must be prepared and polished according to the manner before directed for other engravings, p. 46, and afterwards divided equally, by lines

parallel to each other, and traced out with chalk that is very soft, for fear it scratch the plate. The distance of these lines from each other should be about a third of the length of the face of the cradle which is to be used, as not more than that proportion of the instrument, from its form, and the rounding of the corners, will take at the same time upon the copper; and these lines should be marked by capital letters or strokes of the chalk. The cradle is to be then placed exactly betwixt the two first lines, and passed forwards in the same direction, being kept as steady as possible, and borne upon with a moderate force. The same must be repeated with respect to all the rest of the lines, till the instrument has been thus passed over the whole surface of the plate. Other lines must be then drawn from the extremities of the other two sides in the same manner, which, intersecting the first at right angles, will, consequently, together with them, form squares; and the same operation must be repeated with the cradle as in the case of the first. New lines must then be drawn diagonally, or cornerwise, on the plate, and the cradle passed betwixt them as before; and when the first diagonal operation is performed, the lines must be crossed at right angles as the former, and the cradles passed betwixt them in the same manner.

The plate having undergone the action of the cradle, according to the disposition of this first order of lines, a second set must be formed, having the same distances from each other as the first; but they must be so placed as to divide those already made into spaces one third less than their whole extent; that is to say, every one after the first on each side will take in one-third of that before it; as, for example, beginning at A, of which the first third must be left out, a third of B will be consequently taken in, and so of the rest. These lines of the second order may be either marked with small letters, or lesser strokes, to distinguish them from the first; and the same treatment of the plate, with respect to them, must be repeated as was practised for the others; and this must be understood to extend as well to the diagonal lines as those parallel to the sides of the plate.

When this second operation is finished, a third order of lines must be made; the first of which, suppose in A, for example, must omit two-thirds of it; and, consequently, take in two-thirds of B; and so of the rest; by which means the original spaces will be exactly divided into equal thirds; and the cradle must be again employed betwixt these lines, as before, in the case of the others.

When the whole of this operation is finished, it is callen *one turn*; but in order to produce a very dark and uniform ground, the plate must undergo the repetition of all these several operations for about twenty times, beginning to pass the cradle again betwixt the first lines, and proceeding in the same manner through all the rest. But it may not be impertinent to repeat the caution that the cradle should not be too hardly borne upon, and that it should be passed cross the plate with one motion only, without stopping or varying the action, for fear of making spots or inequalities in the black of the ground, and that the grain may have the soft and velvet-like look in every part; on which indeed depends the beauty of this kind of engraving.

This uniformity of the ground is therefore of so much consequence that it should be examined, and even tried with the greatest care, before the scraping be begun; since, if it prove bad, there is no remedy; but the labour already bestowed on the work, when it shall be discovered to be so, must be given up, which is generally the best compromise; for, otherwise, with great pain and embarrassment, a defective work will at last be produced, even though by the hands of the most skilful.

SECT. IV.

Of the manner of Scraping in Mezzotinto.

WHEN the plate is prepared with a proper ground, the sketch must be calked on it by rubbing the paper on the backside with chalk. But as this kind of white is very apt to come off, and consequently the

tracing made with it to be defaced, it is proper to over-
trace it afterwards with black lead, or, what is better,
Indian ink; for common ink is improper, as it remains
in the grain, and is not to be got out without a great
deal of trouble.

The scraping is then performed by paring or cutting
away the grain of the ground in various degrees, so that
none of it is left in its original state, except in the
touches of the strongest shade. The general manner of
proceeding is the same as in drawing with white upon
black paper. The masses of light are first begun with;
and those parts, which go off into light in their upper
part, but are brown below. The reflections are then
gradually entered upon, after which the plate is black-
ened with a printer's blacking-ball made of felt, to see
the effect; and then the work is proceeded with, ob-
serving always to begin every part in the places where
the strongest lights are to be. But the greatest caution
should be taken not to pare away the grain too fast in
hopes of having sooner finished; for it is not easy to
replace it when it is once taken away, especially in the
lights; and there ought always to remain every where
a slight cast of it, except on shining parts: as it will,
nevertheless, happen, after all possible attention, that
the grain will be taken off more than is proper in some
places, the little cradles of different sizes, spoken of in
describing the instruments, are then called in aid to re-
store it.

S E C T. V.

*Of the application of the art of scraping Mezzotints to the
Printing with a variety of Colours, in order to produce
the resemblance of Paintings.*

THE art of printing such a variety of tints as may
compose a painting without multiplying the plates
to a proportionable number, was established by Mr. Le
Blon upon this principle: That there are three primitive
colours, of which all the rest may be composed, by mix-
ing them in various proportions;—that any two of these

colours being mixed together, preserve their original power, and only produce a third colour, such as their compound must necessarily give; but if transparent colours be mixed, and the three primitive kinds compounded together, they destroy each other, and produce black, or a tendency to it, in proportion to the equality and inequality of the mixture;—and that if, therefore, these three colours be laid either separately, or upon each other, by three plates, engraved correspondently on these principles to the colouring of the design, the whole variety of tints necessary may be produced.

The requisites, therefore, to the execution of any design in this method of printing, are as follow :

First, To settle a plan of the colouring of the painting to be imitated, shewing where the presence of each of the three simple colours is necessary, either in its pure state, or combined with some other to produce the effect required; and to reduce this plan to a painted sketch of each, in which not only the proper outlines, but the degree of strength should be expressed.

2dly, To engrave three plates correspondently to this plan, which may print each of the colours exactly in the place where, and proportion in which they are wanted.

3dly, To find three transparent substances proper for printing with these three primitive colours.

The first of these requisites is the most difficult to be performed, as it requires a thorough comprehension of the nature of colours in this view, as well as some experimental skill and judgment to settle the necessary system, both of the simple and combined effects, in order to produce the due combination with harmony and proper keeping. The second is not so difficult as the first, if that be well executed, and requires more of care and labour, than of skill and judgment; but particular regard should be had that the plates be exactly alike in dimensions and form; for the least irregularity or disproportion renders the whole attempt abortive.

The third can never be completed but in an imperfect degree, as we have not any such substances in the *Materia Pectoria* as correspond fully with what is here wanted; which is to have three pigments perfectly trans-

parent, pure, or bright, and agreeing in their tone of force and colour. A blue we have, in the Prussian blue, when it is very good in its kind, that is not very exceptionable; and lake of the best sort (could it be procured) would afford a red, which, though not so near the proper standard as the best Prussian blue, might still well enough serve; but for yellow, brown pink (which is the only transparent pigment deep enough for this purpose) has never been hitherto produced so as to correspond, either for strength of colour or brightness, with either fine lake or Prussian blue; and this must therefore be considered as an hitherto unobtained requisite for carrying on this art to the first degree of perfection. These three must, however, be the pigments employed; and the Prussian blue must be light in the pigment, otherwise it will greatly overpower both the others; but it should be as bright as possible, to which quality deepness or strength of colour should be added likewise in the choice of the others for this purpose.

The method of engraving plates by scraping in mezzotinto had rendered this art of imitating painting more easily practicable, as far as regards the execution, with respect to the printing. For the several plates that are necessary to be engraved correspondently to each other, are much sooner done in this way than they could be in any other; and the particular manner Mr. Le Blon used in preparing them was as follows:

The three plates of copper were first well fitted, with respect to size and figure, to each other, and grounded in the same manner as those designed for mezzotinto prints, and the exact place and boundary of each of the three primitive colours, conformably to the design, were, as above-mentioned, sketched out on three papers answering in dimensions to the plate. These sketches were then calked on the plates; and all the parts of each plate, that were not to convey the colour to which it was appropriated to the print, were entirely scraped away, as in forming the lights of mezzotinto prints. The parts that were to convey the colour were then worked upon; and where the most light or diluted tints of the colour were to be, the grain of the ground was proportionably taken off; but where the full colour

was required, it was left entire. In this, regard was had not only to the effects of the colour in its simple state, but to its combined operation, either in producing orange-colour, green, or purple, by its admixture with one alone, and likewise to its forming brown, grey, and shades of different degree, by its co-operation with both the others. But though the greatest part of the engraving was performed in the mezzotinto manner, yet the graver was employed occasionally for strengthening the shades, and for correcting the outline, where it required great accuracy and steadiness. It was found necessary sometimes to have two separate plates for printing the same colour, in order to produce a stronger effect; but the second plate which was used to print upon the first, was intended only to glaze and soften the colours in particular parts that might require it. With respect to the black and brown tints, which could not be so conveniently produced, in a due degree, by the mixture of the colours, umber and black were likewise used.

The explanation, or the manner of printing with these plates, will be reserved till the method of printing in general with copperplates is treated of. But with respect to the order in which the plates are to be applied, it may not be improper to observe here, that the colour which is least apparent in the picture should be laid on first; but that which is betwixt the most and least apparent next; and that which predominates last, except where there may be occasion for two plates for the same colour, as was before mentioned, or where there is any required for adding browns and shades.

Mr. Le Blon applied this art to portraits, and shewed by the specimens he produced, the possibility of its being brought, by farther improvements, to afford imitations of painting which might have some value. It is, nevertheless, much better adapted to the simpler subjects, where there are fewer intermixtures of colours, and where the accuracy of the reflections and demitints are not so essentially necessary to the truth of the design, from the greater latitude of form, and disposition of the colour, as in plants, anatomical figures, and some subjects of architecture. But perhaps plates en-

graved, or rather finished with the tool, particularly with respect to the outline, would be better accommodated in some of these cases, than those prepared only by scraping. In relation to plants, it were much to be wished this method were cultivated; as they might with the same, or less expence, be better depicted in this manner than by the washing prints, as is now so much the practice. Two sets of coloured representations, one of the system of medicinal plants, and the other of the indigenous, done in small, so that by putting a number in a plate, the price may be rendered moderate, are much wanted for common use; and might be easily done in this way, as the neatness of the execution would not be so material as the justness and accuracy of the design, so far as relates to the botannical truth and propriety. It is to be feared, however, that as this art has been totally neglected, as to any attempts that have had the probability of being effectual, ever since the death of Mr. Le Blon, it will remain so still, unless revived by the patronage of some great person or society, who may conveniently bear that expence which artists on their own account, whether with respect to their time or money, cannot prudently engage in.

Mr. Cochin remarks, at the end of an account he has given of Mr. Le Blon's manner, that though this ingenious artist confined his method principally to the use of three colours, yet should this invention be again taken up and cultivated, there would be more probability of success in using a greater variety, and that several different kinds might be printed by one plate, provided they were laid on in their respectively proper places by printing balls, which should be used for that colour only. His hint might be however very greatly improved by the further assistance of stencils accommodated to the plates, for the laying on the colours in the proper parts.

What he observes would be more particularly true with respect to pictures of plants; for in that case, not being confined to transparent pigments, which have not force enough for the vivid colours of flowers, vermillion, King's yellow, and others of a strong body might be used, and with much less pains than by working on Mr.

Le Blon's principle, where the study required in making the plan of colouring, and the care and nicety demanded in the execution of it, more than countervail the trouble or expence of an additional plate or two.

CH A P. VI.

Of the manner of Printing Copperplates.

SECT. I.

Of the Instruments necessary for Printing Copperplates.

THe instruments and utensils employed in printing copperplates are a rolling-press, with all its appurtenances, a printing ball for spreading the ink on the plate; a lesser ball for cleaning the plate after the impression is over; a pot with a cover for boiling the ink; an ink vessel for containing it during the time of printing; a fire pan and grate for heating the plates; blankets for laying over and under the plates on the table of the press; a piece of broad cloth for laying over the plate; and a knife for cleaning the printing ball.

The rolling-press is the principal, and indeed the only very important machine or instrument employed in printing copperplates. But as the giving a detail description of it, such as would be sufficient to enable a workman to fabricate one, would take considerable room in this volume, without any equivalent advantage, I shall wave it; having nothing to offer with respect to the improvement of the construction, and the common kind being at present to be procured of those whose proper business it is to make them.

The printing ball is only a piece of white linen formed into a ball by rolling it together as for a bandage, but much more tightly, for the harder it is the better. It should be formed into a conical shape, like the figure of a painter's muller for grinding colours; and then rendered compact and secure from unfolding, by means of strong thread several times doubled, and passed through it in many different places, by a kind of awl; and at the same time fastened by sewing, so as to reduce it to the size of three inches diameter, and of five or six inches in height, or thereabouts. It must afterwards be pared flat at the bottom, by cutting it evenly with a very sharp knife; and the other end must be fashioned by sewing into the figure of a half ball, that it may bear the pressure of the hollow of the hand in grasping it, to ink steadily the plate with the more convenience. This ball should be made of fine soft linen half worn.

A lesser ball is also necessary for oiling and rubbing the plates after the impression is over. It should be made of serge rolled up, and fastened together, in the same manner and figure as the printing ball.

The pot for boiling the ink should be of iron, and proportioned in its size to the quantity of ink required to be made. It should be, however, at least a third bigger than will contain what may at any time be put into it. It may be in the form of those used for culinary purposes, but must have a cover which should be thick, and fit the top of the pot, so as to close it very exactly.

The vessel for containing the ink during the printing is a kind of square trough, of which three sides are raised high, but that in front made low; the real hollow or containing part being shallow, and formed in the front part, by raising the bottom, as it were; which raised part of the bottom is brought forwards, so as to make a sort of border or rim, on which the printing ball is laid, when it is not immediately in use.

The fire-pan should be of iron, and made bigger than the largest plate, for which there may be occasion to use it. The depth must be in some proportion to the diameter; but need not be much greater than will keep the plate, when laid over it, three or four inches above

the coals. There must be a grate fitted to it of a square form, and supported by four legs, the dimensions of which must be such as will admit the pan to be put under it. Betwixt the legs and this grate the pan may be fastened by rings and hooks, so as to hang in its proper situation under the grate, but to be removed at pleasure. The use of this grate is to bear the plates when laid over the fire in the pan, and to give air to the coals, to prevent their extinguishing.

A trough, or tray of copper, must likewise be had for dipping the paper. It should be of a long square form, and as big as the paper called the large eagle, or at least as broad, if a little less in length, and ought to have rims round it of the height of eight or nine inches. Along with this should be two strong boards latticed behind, of the size of the paper before mentioned; one of which should be latticed on the back, in order to give room for the fingers to pass under it, where they may be occasion to remove it from place to place.

A knife must also be had for cleaning the printing balls, and the other utensils, when fouled with the ink; the form may most conveniently be the same with that of the palette-knives of painters, only it should be large and strong.

Cloths must also be provided for laying over the plates when put within the press; they should be of woollen-cloth well milled, but not stiffened. When they are applied to this use they are called blankets; and indeed the kind of flannel called swanskin is commonly used here. In France the printers, who are particularly curious, have some of fine serge, with both sides wrought in the manner of the wrong side; of which they put one next the plate, and then lay two or three others of the common kind over it. They should be had of different sizes, according to the plates and paper there may be occasion to print with; and as, in consequence of passing under the weight of the roller, they may be rendered too hard or too soft; care ought to be taken to spread them in the evenings and mornings before they be used, and to twist and ruffle them, in order to render them supple. Several sets should be provided to admit of their being washed when they are too hard or loaded

with the gum, which the paper imparts to them in the printing as they pass together under the roller. Besides these softer kinds of cloth, called blankets, it is practised here to have some of broad cloth for laying immediately over the plate.

Linen cloths should also be procured for several purposes, for the greatest part of which such as are worn out is most proper. This kind should be had in plenty, because some should be appropriated to each use.

SECT. II.

Of the Printing Inks.

HAVING before, in the part where inks are treated of, given the best recipe for preparing this kind, it is needless to repeat it here, as it may be found in p. 32; but it may not be amiss to observe, that nothing can be of more consequence to this kind of printing than the good or bad qualities of the ink; for, besides the rendering the prints of little value when the consistence or colour of the ink is bad, the plates themselves frequently suffer extremely from a slight use by the corrosion of bad ink. It is, therefore, most expedient for all who are concerned in this kind, in the case of works of any value, to prepare the ink themselves, which they may be certain of doing to perfection, by following the directions of the recipe above referred to, and can meet with no difficulty, except in procuring the best German black, which may be had either from Frankfort, where it is made, or from Holland or Paris.

SECT. III.

Of the manner of Printing Copperplates.

THE press, with all the other utensils, being prepared, the table must be put into it and adjusted, which is done by thrusting the thinnest side of it between the rollers, and, at the same time, turning the

press with the other till the rollers come over it; and if the press have not been used before, since the parts of it were put together, it is requisite to try if the two rollers close properly on its surface above and below. The manner of this trial is to draw with Spanish white (or chalk, prepared by washing) a right line along the length of the table of the press, and another broadways. If the roller be passed over the table, and the line appear marked perfectly on it, without any break or faintness in any particular part by the turning the press, it may be concluded all is right; but, if the contrary be found, the press must be adjusted by adding, on the sinking side, more of the cartoons which are put into the openings of the cheek of the press till the rollers be brought to a due level. The printer must then place himself, standing with his face towards the press, having the greatest part of the table brought forwards at his side, and put, in the most even manner, one of the blankets on the table; and afterwards two or three others upon it, in such manner that the uppermost of them may spread beyond that under it, and that beyond the next; and so of the rest, when there are more. This is proper in order that the roller may take more easily on each of them, when the cross is turned; for it is obvious, that being disposed thus by gradation, the upper roller, in being drawn over the table, will rise more easily upon the blankets in this state. When the measure of an inch is thus gained in the size of the uppermost cloth, the printer must turn them evenly all together upside down on the roller; and then take a sheet of white paper, of the size of those that are to be printed, and spread it in the middle of the table, and gum it down; the design of which is to mark out the place where the plate should lie, that he may the more readily put it each time an impression is to be taken from it in its proper situation.

The press is then properly prepared to receive the plates; but before we proceed to the explanation of the particular manner of passing the plate and paper which is to be imprinted, through the rollers, it is proper to describe the preparation of both to undergo this opera-

tion, the paper by being moistened, and the plate by being duly charged with the printing ink.

In order to moisten the paper, five or six sheets must be taken, and being held extended with both the hands, they must be dipt into the copper trough, or tray, before mentioned, p. 138, which must be half filled with clean water; and this dipping must be instantly repeated two or three times, according as the strength of the paper, or the quantity of gum in it may make necessary; but the sheets must be kept exactly even and free from all folds. They must be then put, in the same even state, on one of the pieces of wood above directed to be prepared for this purpose; and the same must be done of the remainder, laying parcel after parcel one upon the other, till the whole be dipt. The other piece of wood must be then laid upon them, with the even side downwards, if either be latticed, so that the paper will be inclosed betwixt the two boards; and over the uppermost board a considerable weight should be put, that the water may be forced into all parts of the paper alike, and the superfluous quantity pressed out. They must be left thus loaded till there be occasion to take them away to print them: and it should be so calculated that a night's time should be afforded for them to lie in this condition before they be printed, in order that the water may drain properly from them; but if they be not used the next day, they should be dipt over again for the consumption of the day after, as they grow too dry if continued longer in this state than twenty-four hours. Care should always be taken to adapt the dipping to the strength and gumminess of the paper: and it should be observed, that such as is designed to be imprinted with plates done by the graver, should be kept longer after dipping than any other. It is sometimes necessary to alum the paper, which may be performed by melting the due proportion of alum in hot water, and adding it to that in which the paper is dipt, so long before as to give time for the mixture to grow cold before it is used.

The above is the direction given by Mr. Cochin; but there will rarely be found any paper that can be brought to a state for printing in so short a time; for

the gum in paper of such thickness, as is used for caperpiates, prevents the water from diffusing itself, and rendering the paper equally moist and soft in every part, as will be easily seen on holding the paper up betwixt the eye and any light by the opaque spots. The best practice is, therefore, after the dipping, to sheet the paper; that is, to lay it straight on the boards sheet by sheet, and then to put on the upper boards, as above, and suffer it to lie about three days. It must then be passed under the roller of the press, by separate parcels, as many sheets being in each parcel as the press will admit. After this it must be again sheeted, and put on the boards, and there left at rest for a fortnight, or three weeks, *to rot*, as it is called by the printers, till the whole be entirely free from spots, and equally transparent. The precise time for rotting varies greatly, according to the thickness and gumminess of the paper, and cannot therefore be reduced to any rule; but it must be judged of by examining the paper from time to time, which will be always fit when the whole is equally transparent and free from spots. If, as it sometimes happens, the paper be found to be mildewed, it must be hung upon cords, each single sheet, till it be near dry, and then must be dipt and pressed again when it is to be used; but a second rotting is not necessary. The dipping and pressing must be practised in the same manner, if at any time the paper grows too dry before it can be printed off.

The manner of inking the plate is thus: Being engraved, filed, cleansed, and every way ready for printing, it must be laid on the grate described p. 137, with its back towards the burning coals, which must be previously put into the pan intended to contain them, and described p. 137. But the coals should be previously covered with ashes, to make them burn more equally, and last the longer time. Having suffered the plate to be a little heated, it must be taken in the left hand by one of the corners, and, being held steadily and flat over the grate, and the printing ball being taken in the right, and dipt in the ink, the plate must be rubbed all over with it on the engraved side, which will of course be uppermost; and by gliding and pressing the ball, and

beating strongly with it in every direction, the ink must be driven into all the minutest hollows of the graving in every part of the plate. But if the plate be new and large, or where there are strokes of the graver long and deep, as in the square or border round the edge, the ball must be again carefully passed over these strokes, and ink even put there with the finger, by running it along the deep lines, to fill them with, and make them hold it. This is, nevertheless, only necessary for the first print; for afterwards there will remain enough always in the lines, to furnish, by means of the supply given in the common manner of inking the plate, a sufficient quantity for those that succeed.

When the printing ball is new, four or five times as much ink should be taken as there is occasion for, when one used before is employed; because, after being well satiated with the ink, it requires only to have the surface covered, not imbibing any more. It must be remembered likewise, to put the printing ball always on the plate where it ought to be; that is, the rim or raised bottom in the front of the ink vessel, that it may get no dirt or sand, which would scratch the plate; and it can scarcely be kept from such foulness if it be put at random in other places. When it happens, that after having printed much, or having discontinued for some time, the ball becomes hard at the bottom, on account of the ink which sticks there, and gains a tenacity in drying, a thin slice of it must be taken off with a very sharp knife, and the ball must be charged well with ink before it be used again.

The ink having been thus made to enter thoroughly the lines and strokes graven on the plate, and the printing ball being put in its proper place on the border of the ink vessel, one of the cloths or clouts made of old linen must be taken off, and the body of the printing ink which lies on the plate, as well as that which sticks to the back and sides of it, must be gently wiped off, then the first clout being put away, but left upon the grate, or somewhere at hand, the plate should be carried to the table and laid down on it, which ought to be placed for that purpose at the head of the grate; and the hand being passed slowly, but hardly over the plate,

all the redundant ink, that is, such as is not actually lodged in the strokes or hatches of the gravings, should be taken off by degrees, observing to wipe off the ink, from time to time, from the hand that is thus employed, with a clean clout, which must be held in the other hand, with which also the plate must be steadily fixed, that it may not slide and get loose in going over it with the flat part of the other hand to clean it; which must be done, as is above intimated, by running the hand along it, sometimes lengthways, sometimes breadthways, and also diagonally, and in all other directions, that there may not remain the least ink but in the strokes where it is necessary. When it appears that there is not any more ink or spots in any part of the surface of the plate, where there is no engraving, the border and edge must be also wiped, and even the table where the plate has been laid to be cleansed; and the plate must be then put again upon the grate, and the hand being cleared from the ink, must be rubbed with Spanish white; after which, the plate being moderately heated, must be carried back to the table, and the whitened hand passed slightly over it, which is very serviceable in the case of plates engraven in large portraits, and in that of other works which require more care and attention than ordinary; but it is not absolutely requisite, and therefore may be dispensed with on common occasions, where despatch is the greatest advantage that can be had in the manner.

Great care must be taken after this not to touch the plate in the places where it is engraved, for fear of its contracting any dirt; and it is proper to intimate here, that things must be managed in such manner as to avoid wiping the plate with sweaty hands; for rather than that should be, it is better to wipe it with a rag, as many printers do at present in the case of pieces of architecture and other works that do not require so much nicety in the treatment as portraits. When this is done, however, after having left the first rag on the grate, they take another cleaner, which should lie ready on the table, and wipe it with this also; and after the plate appears to be clean, having wiped, as above directed, the border, edges, and under side, they take a third

linen rag, moistened with clean water, and pass it over the whole plate, to finish the cleaning all that part of it which ought to leave the print white. It may be conceived from what has been said, that it is not necessary the first rag should be of fine linen nor clean, as being used only to take off the ink grossly, and may serve therefore for a long time, provided the ink does not dry upon and harden it; and with respect to the second clout which is used for this purpose, when it becomes moderately dirty, it should be applied to the first use, and another taken in its place; but the last should be always fine, and as soon as it appears soiled or dirty, it should be applied to the purpose of the second, and whenever a fresh one is taken, it should be with a sponge as those preceding, the sponge being kept wet in a pot with water ready for this use. Some printers make use of urine instead of water; but that is very detrimental to the plates, and sullies the white of the prints by the number of spots and little holes which it makes in the copper, on which account it ought to be absolutely rejected. The printer, besides these clouts, should have a towel lying before him on the table, and likewise a little white linen cloth fastened to his belt to wipe his fingers before he takes hold of the sheets of paper, in order to their being printed, as well likewise as when he is to take them away again after they are printed.

Every thing being thus ready, the printer must take the plate by the back and sides, and lay it carefully on the paper fixt on the table, as above mentioned, to mark the proper place; and having wiped his fingers on the towel, which is hung near at hand for that purpose, he must take one of the sheets of paper prepared by moistening and rotting, according to the manner above directed; the whole quantity of which ought now to be placed on the head of the press, and put it gently and evenly upon the plate, so as to cover it exactly; and upon that he must lay a sheet of blotting paper wet with a sponge dipt in water, and over them the blankets that were hung on the roller; or, according to the better practice which now prevails here, a piece of broad cloth as above mentioned. He must then turn the cross of

the press equally and slowly, till the whole has passed to the other side of the press; but if the plate be not of an equal thickness in every part, it is necessary to put pieces of cartoon, or other thick paper, betwixt it and the table, so as to bring it to a proper level.

When the plate has thus passed to the further side, so that the roller no longer bears upon it, but only on the further edge of the blanket, the printer must again turn the cross of the press the contrary way, and make the table and the plate repass back to their former place. This is always advantageous in works that are fine and of importance, because it secures the certainty of a better impression. But for despatch, it is frequently practised to pass the plate only once under the roller, and not to return the table to its place, but by passing a fresh print under the roller: in order to which the printer goes to the other side of the press, when he takes the plate out of the blankets. This is not safe, nevertheless, where impressions require the greatest accuracy; but in the case of maps, or other coarser engravings, it may be admitted, and saves some time and labour. Whichever method be pursued, the subsequent proceedings must, however, be thus: The printer, when the impression is in this manner made, by passing the plate under the roller, either twice or once, must raise the blankets, and turn them over the roller as they were at first; and then take off the broad cloth or blotting paper mentioned above to be laid over the paper on which the impression is now made. He must then carry it to the grate, and suffer it to grow so warm, that the paper may be sensibly drier than when the plate was taken out of the blankets.

After this, having wiped his fingers on the linen cloth which hangs to his belt, he must take up by the two corners the sheet of paper which is on the plate, for fear the black of the ink may smear the paper; and having laid it down by him, he must again carry the plate to the grate to be inked as before, and proceeding the same as to the rest of the operation as he did with the other.

It is proper to mention, that for the convenience of the printer, there should be near each side of the press,

or in some commodious places close at hand, two boards or planks, put upon something that will raise them breast high, and covered with a sheet of grey paper, upon which the prints may be laid evenly one upon another as he passes them through the press, (or *pulls them off*, to use the printer's phrase.) The reason of having two of them is, that when he stands on one side of the press, he may have one there, and when at the taking off the next print he removes to the other, he may still find another equally near him, the moistened paper to be printed being put on the head of the press, as was before intimated.

When the printer has done his work, he hangs on cords, that are clean and drawn tight, all the prints he has taken off; which, if it cannot be conveniently performed the same evening, should be done the next morning; and when they are thus hung, they must be left till both the moisture of the paper and that of the printing ink be dried away. After which they must be taken down, and putting them together dozen by dozen into the press, to take away the creasing of the cord, he leaves them there a day or two; when, being carefully laid one upon another, they should be put into some box or other proper repository, which will complete the drying, and bring the ink to its proper colour.

In the mean time, after having taken off as many prints as are thought necessary from the plate, the printer takes likewise a little ball, which is formed by rolling together a piece of some of the old blankets, or any other woollen stuff, in the manner of the printing ball, or any other commodious form; and, having oiled it well, he heats the plate a little upon the grate, and then rubs it strongly with this oiled ball. By this means the ink in the strokes and hatches is rendered thinner, so as to be afterwards wiped out by rubbing with a clean linen clout; but to be certain that the least ink may not be left behind, they take off a proof on a sheet of blotting paper moistened with a sponge.

This blotting paper, being afterwards well dried, they wrapt up the plate in it to preserve it from the dust, putting one of the prints upon it, in order to dis-

tinguish it, and they lock it up in some proper place, where it may be well secured from contracting the least moisture.

If the duly cleaning the plate in this manner should be so neglected that the ink should dry in the strokes or hatches, which would make the next proofs taken from it appear weak, and as if the plate had been worn out, this ink must then be got out by the following means.

When there are several to be so cleaned at the same time, then take the copper vessel or trough, which serves for dipping the paper, and set it upon two tall dogs, or any other thing to support it, and make a fire under it; putting it into all the plates, with a quantity of wood ashes sifted, some pot-ashes, and a considerable proportion of water. They then suffer the lye, made by the water and ashes, to boil several hours with the plates in it, and then they take them out and wash immediately in another vessel full of clean cold water, to free them from all the ashes, and afterwards set them to drain, being reared obliquely against a wall or other support. They then wipe them very carefully to prevent any ashes or sand remaining, which might be liable to scratch them. When there is one alone to be cleaned, and that is of a moderately large size, they place it on the grate with the back downwards, and cover all the plate with wood-ashes, which must lie upon it the thickness of a finger, being moistened and dipt in water before they be used for this purpose. They then make a clear and strong fire under the grate, to heat the plate, and make the moisture in the ashes boil upon it; and, after some time, the lye formed by the moisture and ashes will attract and dissolve the ink, in the strokes of the engraving, so as to render it very easy to be cleaned, by washing it copiously with water poured upon it.

This is the method advised by Mr. Cochin; but the use of the ashes is not so commodious as the adding the salt which they contain, and which is indeed the only efficacious part, the earth of the ashes not being capable of producing any effect but that of scratching the plate. The best method, therefore, is to use a proper quantity of the pearl-ashes, which is nothing more than the salt

extracted from wood ashes, and which being dissolved in warm water and then purified, either by filtering or decanting off the clear part, after it has stood some time to settle from the dregs, will answer the end much better than using the crude ashes, in which the earth is detrimentally to this purpose mixt with the salt.

As there is sometimes occasion to print on paper which is first guilt, a difficulty is apt to arise in making the printing ink take to the gold. In this case the remedy is, to mix with a portion of the oil of the size of an egg, half a spoonful of ox-gall, mixt and incorporated with a little vinegar and salt; but care must be taken not to make this composition more than two or three hours before it be wanted; because, if it be kept much longer, it will of course be spoilt.

When there is occasion to print with different colours, the same method may be observed in the case of brown, or such other colours as derive no advantage from brightness in preparing the ink as for common prints. But where purer colours are in question, fat oil, mixed with old nut oil should be used instead of these prepared by heat; and if gum-mastic or sandarac be melted in the nut oil employed for this purpose, using only such a heat as cannot brown the oil, it will be found of advantage.

It may not be unnecessary to explain here what is meant by proofs and counterproofs. By a proof is understood, the first, second, and third sheets that are printed off from a new plate; or one that is begun to be used again, after having been laid by. The counterproof is made in the following manner: A proof, fresh pulled off, is laid on the plate with its back downwards; and upon it is laid a blank sheet of the paper ready wet for printing; and over this a sheet of blotting paper is put and the blankets turned over the whole. The cross of the press is then turned, and the plate and proof passed under the roller. The sheet of paper being afterwards taken off, the proof will be found to have calked an impression of the print upon it; and this is called the counterproof; which is commonly taken with design to be better able to see how to correct and retouch the plate; because the impression in

it is turned the same way as the drawing and the plate, and it is always more tender, that is to say, less black than the proof, which consequently makes it more easy to be worked upon in retouching and correcting the design.

SECT. VI.

Of the method of producing Washed Prints much more beautiful than the common.

MR. COCHIN observes, that considering with attention the prints washed with several colours to imitate paintings, it occurred to him, that it would be better to do the contrary of what was commonly done in the manner of such washing; for instead of applying the colours upon the impression, he imagined it would be much more advantageous to print upon them, which he advises to be performed in this manner.

Supposing, for example, there was a plate perfectly engraved with a figure which it was desired to clothe with two or three colours; as the hat grey, the hair brownish, the cloak red, the coat of some other colour, and the stockings still different, another plate of copper should be then procured, thoroughly well polished, and then filed and fitted exactly to the size of the first, in such manner that, being put together, all the corners and edges may exactly coincide with each other. Having varnished this unengraved plate with the white varnish, as is directed p. 100, let a proof fresh pulled off from the engraved plate be laid upon the varnished plate, exactly in the place where the engraven plate has given the impression. Spread then two blankets upon the table of the press, and lay the varnished plate upon them with the proof lying on it; and having covered them with two or three other blankets, pass them under the roller of the press. When the blankets and proof are taken off the plate, the white varnish will be found to be printed with the same impression that was on the proof in the manner of a counterproof; and the out-

lines of the hat, hair, cloak, &c. must be traced with a very fine needle, and the plate then corroded gently. After this the varnish should be taken off from the plate, and some proofs should be taken from it on strong paper alumed, or upon cartoon very thin and well beaten, which should be previously moistened by laying in a damp cellar for a night or two, or rather by putting it among the paper moistened in order to be printed. The proofs being made, and the cartoons or paper on which they were printed being dry, the part inclosed in the outline of the cloak should be coloured with a red ground, that within those of the head with a brown ground of bistre, and the same of the rest.

This being done, the sheet thus coloured must be put into the cellar to make it moist; and then having spread some of the blankets on the table of the press, the coloured sheet must be laid on them, with the blank side downwards. After having inked all the first plate that has the entire engraving upon it, in the manner as for printing at other times it must be put upon this leaf with the engraved side downwards, so that the parts, of which the outline is marked on the sheet, may coincide exactly with those correspondent to them in the plate; and then two or three blankets being laid over them, the whole must be passed through the rollers. After which, the sheet, being uncovered, will be found printed upon the colours in a manner that renders the effect much more beautiful than that of those printed and coloured upon the printing, as in the common way.

There are two observations I shall take the liberty of adding to those ingenious directions given by Mr. Cochin. The one is, that, instead of the laying the sheets of paper to be printed in a damp cellar, or within other sheets dipt for printing in the common method, for both which opportunities may be frequently wanting, they may be much more commodiously moistened at all times by the steam of a kettle of boiling water in this way. The kettle being covered, and the steam only suffered to pass through a spout or pipe, the paper, by being held at a distance from such spout or pipe, may be made wet very quickly, in a greater or less degree, as there shall appear occasion. The other obser-

vation is, that when the ink is laid on the colours by printing upon them, there is no general reason for using transparent colours, as is the case in washing the prints; but vermilion, verditer, and others may be used, though of the strongest body, which would be a great advantage, in case plants and flowers, the strength and variety of whose colours demand all the scope imaginable, were to be treated in this manner, as they might be in a way that would render the prints much more pleasing and just than the usual method of washing.

SECT. V.

Of the method of Printing in Chiaro Oscuro.

THE printing in *chiaro oscuro*, is the producing a strong effect of relief, attended with a just and natural gradation of the lights and shades, grounded with brown, with white and black, by printing on paper; by which means a greater latitude, as well as a closer union of the lights and shades, may be obtained, than by printing with black on the paper in a simple state.

This invention was discovered in Italy, in the sixteenth century, by Hugo da Carpi, and appeared to Mr. Le Bosse, to whose hands pieces done in this way came some time afterwards, not only so great but valuable a novelty, that he sought out the method of performing it; and afterwards taught it in this manner:

Two copperplates must be provided of equal size, and exactly fitted one to the other. On one of them must be engraved entirely the design proposed, and then the prints must be taken off from it with printing ink, on sheets of grey paper, in the manner just above directed in the case of washed prints. The other plate must then be varnished likewise in the manner of that for the washed prints, and the varnished side being laid upon the sheet printed by the first plate, they must be passed under the roller, when the print will have made a coun-

terproof on the varnish of the plate; after which the lights must be graved on the plate, and corroded very deeply by *aqua fortis*. The same may otherwise be done with the graver, and even with more ease by those who can use it well.

In proceeding to execute this method of printing, a difficulty always occurs of finding such paper and oil as will admit of being used for printing, without the oil rendering the paper yellow or brown. The best method to get over this, is to use very white nut oil drawn without fire, and to put it into two leaden vessels, and set in the sun till it grow thick in the proportion of the weak oil, of which notice will be taken below, for that which is intended to form this thick oil must be continued in the sun a considerable time. Flake white must then be taken, which, if it be not before prepared, must be ground and washed over till it be extremely fine, and then being dry, it must be ground with the weak oil, of which no more should be used than the least quantity required for grinding the flake; after this the thicker oil must be added in the manner before directed for the printing ink, p. 23. Then having taken an impression with black printing ink, or any other colour from the first plate that is entirely engraved, or coarse grey paper, it must be suffered to dry ten or twelve days; when these prints having been wet, another impression must be made upon them by the plate, on which the lights are engraven, charged with the white flake and oil in the usual manner of printing; taking care that the correspondent parts of the plate, and the impression already made, may be adapted exactly. By this means the printing in *chiaro oscuro* is perfectly performed.

C H A P. VII.

Of Engraving Wood, with a view to Printing.

ENGRAVING in wood, with a view to printing, is performed in an opposite manner to that on copperplates; for in the latter, the lines which are to produce the expression, or delineation on the paper, are sunk or hollowed; whereas, in this kind, they are projecting or raised, as in the case of letter printing.

The instruments employed for this kind of engraving are, with respect to the calking or drawing the design, the same with those used for copperplates, and on other occasions; those employed for the cutting and forming the figure in the wood itself, are knives, chisels, and gouges.

The knives may be formed like penknives, but should round greatly towards the point, and some should be had with very small and narrow blades.

The chisels should be of very different sizes, and made with one side flat, but of very thin substance, that smaller or larger pieces may be taken off with the greater linear exactness.

The gouges, or round chisels, should likewise be of different sizes, and sections of different circles; they may be made in the same form with those commonly used for carving ornaments in wood.

Being prepared with these instruments, the choice of the wood is the next principal care in order to success in this kind of engraving, which can never be possibly well performed but on the proper kind. Beech, pear-tree, and box, are all used for this purpose; but the last is most suitable, being more compact, and having a less grain. Pieces should be chosen which are wholly free from all knots and variation of the texture; and regard

should likewise be had to their having been sawed or divided from the body of the tree according to the true line of the grain; for unavoidable cutting cross the grain renders the raised work too weak to bear the additional disadvantage of being originally impaired, by being sawed off from the trunk in an oblique direction to the lines. It is proper also the wood should be kept a considerable time in the plank before it be applied to this purpose, otherwise, after it is engraved, it may warp before the whole of the impressions there may be occasion to take from it may be worked off; which warping, even in the smallest degree, would entirely spoil it for further use. To prevent this, it may not be improper, where there is a prospect of keeping the wooden print for any length of time, to use very thin plank, and cement it down, as is practised in fineering, upon thick old plank that is thoroughly seasoned, and the additional weight will, in most cases, rather be an advantage than an injury. The thickness of the plank for engraving, where no other is superadded, should be an inch or upwards; but if it be laid on another, then it need not be more than a fourth of that thickness; and the other added to strengthen it, may be an inch and quarter, or half. But this is to be understood only of those intended for very large designs; for in lesser, a proportionable diminution may be made, allowing, always, nevertheless, such thickness as will admit of the cutting without weakening the main substance, so as to hazard the breaking of the print by any slight accident. The wood being chosen, and cut into a proper form and size, it must be planed as even and truly as possible, and will be then ready to receive the drawing or calking of the design to be engraved. But to render the effect of such drawing of calking more apparent, as well as to prevent the running of the ink, if any be used in making the drawing, the following method may be practised:

“ Take white lead, and temper it with water by grinding: then spread it first thinly on the surface by a brush pencil, and afterwards rub it well with a fine linen rag, while yet wet, and, when it is dry,

"brush off any loose or powdery part by a soft pencil."

If the design be sketched on the wood by drawing, it may be done by Indian or common ink, (but the first is far preferable) either by a pen or pencil, or by a black lead pencil, though that scarcely marks strongly enough for finer work. But if, which is more common, when the design is taken from any drawing or print, it is calked on the wood, the means before directed for calking designs on copperplates, or those used on other occasions, may be employed, or figures are sometimes cut out of prints, (which is to be done by taking away all the white part or blank paper) and cemented on the surface of the wood, and in this case gum water only is necessary to hold the paper to the wood. There is another method likewise, which is the laying the entire print smeared over with gum tragacanth on the wood, and, after it is dry, wetting the paper again with water only, and then rubbing it off, by which means the printing ink will be left on the board.

The design being thus sketched on the wood, by drawing, calking, or cementing a former print, the wood must be cut away betwixt the lines of all the several parts, which must be done by the chisels, gouges, or breadth of the pieces to be taken away. In large figures, where the lines run in a light direction, the chisels will perform the work with most expedition and truth, and where curve lines occur, the gouges must be substituted, the knives being principally to be used either for small work, or for repairing larger, where the chisels and gouges cannot be applied with sufficient exactness, or have left parts that want retouching and finishing.

The engraving in wood is much more difficult and tedious than that of copper; because, in cutting it and picking out the separated pieces, the grain of the wood, when it is crossed, renders the remaining parts so extremely fragile that they are apt to break and fly out to the destruction of the effect. This has occasioned the use of copperplates to supersede the other, in all cases, except for very ordinary purposes. But, though this is reasonably done with respect to high-finished prints, yet

in the representation of plants and flowers, and in designs for paper hangings, where the outline only, as is frequently the case, is wanted to be printed, and that in a bold full manner, this method will be found cheaper and more effectual than the use of copperplates.

As the accident above mentioned of the breaking off of part of the raised work is liable to happen frequently, even when the greatest care is taken, it may not be improper to propose a remedy for the defect occasioned by it. This is, to cut out so much of the work as is injured in a square piece, going lower than the wood was cut in the engraving, and then to replace the square part so cut out by another piece exactly of the same form and size, which should be fixt in its place by means of isinglass glue; and, after the glue is thoroughly set and dry, planed to an exact level with the projecting parts of the engraved wood, and then engraved over again, the parts of the design or figure to which it corresponds being previously drawn or calked upon it.

The manner of printing with wooden prints is much more expeditious and easy, though the trouble and difficulty of engraving them be much greater than that of copperplate; because they require only to be dipt in the printing ink, and impressed on the object in the same manner, and with the same apparatus, as the letter printing is managed; and for purposes that do not require great correctness, the impression is made by the hand only, a proper handle being fixed to the middle of the print, by which it is first dipt in the ink, spread by means of a brush on a block of proportionable size covered with leather, and then lifted up instantly, and dropt with some little force on the paper, which is to receive the impression.

PART III.

Of the Nature and Composition of Glass, and the Art of Counterfeiting Gems of every kind.

CHAP. I.

Of Glass in general.

BY glass, as here treated of, is to be understood the artificial vitrifications of bodies, made to answer some useful purpose, either in domestic necessities, or other articles of commerce; and the observations and directions given with regard to it, in this treatise, are such only as respect the improvement of the art of preparing and compounding the kinds applicable to these ends in the different manufactures of it; for the more speculative and philosophic disquisitions on its nature are avoided, where they lead to no principles that are capable of being applied to practice. The methods of modelling and forming it into all the variety of vessels and other figures into which it is wrought, are likewise omitted, because they are already, or may be by other means, well known to those who have any concern with them as an employment; or, like all other occupations of artisans, may be much more easily and better learnt by such as are desirous to be initiated into an operative knowledge of them, from an inspection of actual works,

and trials to imitate what is there to be seen done, than they can by the most explicit verbal directions.

The manufactured glass at present in use may be divided into three general kinds; white transparent glass, coloured glass, and common green or bottle glass. Of the first kind, there is a great variety of sorts, according to the several purposes intended to be served by it, either for making domestic utensils, or lights for inclosed places; and of the second there is likewise a still greater multiplicity of species, differing in their colour, or other properties, according to the occasions for which they are wanted; but of the last there is no distinguished difference of sort, except what the accidental manner of preparation and management, practised according to the skill or art of particular directors of manufactories, may occasion.

In order, however, to speak more intelligibly of the nature of the manufactured glass to be here treated of, it is proper to give some distinct notion of vitrification in general. But I shall not endeavour to push the matter to those almost metaphysical lengths to which Becher, Stahl, and others, have endeavoured to carry it, even far beyond the conclusions which can be supported by inductions from sufficient experiments. Vitrification then (according to the more general and obvious notions of its nature) is a change which may be wrought in most kinds of fixt bodies, or rather in all, under some circumstances, by the means of heat, applied in various degrees, according to the various nature of the bodies; from which change they become fluid, and continue so while kept in the same, or any greater degree of heat, and, when become cold, acquire transparency, fragility, a great but not absolute degree of inflexibility, a total want of malleability, and insolubility in water. All these qualities are inseparably attendant on perfect vitrification; though there may be many preparations of artificial glass, even among those that are in common use, in which some of them are wanting. But this is, nevertheless, only where the vitrification is immature, or where there is an admixture of other bodies with the vitrified matter, as in the case of the opaque white glass, in which the matter giving the milky colour is in an

unvitrified state, and consequently destroys the transparency; or, in the compositions where too great a proportion of salts is used, when the glass produced will be soluble in water, though perfect with respect to all the other qualities. In both these cases there is the presence of an heterogeneous body, besides the proper glass, and therefore, if the whole mass be considered as in a vitrified state, it must be deemed to be an imperfect one, though the composition, in the instance of the white glass, be adapted by this very circumstance to the economical purpose for which it is intended. The same principle will be verified, on a due examination, in all the other sorts of manufactured glass, as well as in the accidental commixtures where the appearances of the glass disagree with the system of qualities required, in the above given definition, to the perfect constitution.

From the nature of vitrification, (it therefore appears that all fixed bodies are capable of being the materials of perfect glass under some circumstances. But as the means of vitrification are limited with regard to the manufactured glass, such bodies only are proper to become the ingredients of the perfect kinds of it as are easily to be procured in due quantity, and admit of being vitrified by the heat of a furnace either alone or by their commixture with others, which may promote this change in them; and in the case of the imperfect sorts, such as that above mentioned, bodies that are not capable of being vitrified by the means there employed, are also taken in as materials, where they are required to give the particular properties wanted in each peculiar sort. The principal substances, therefore, that are chosen for the composition of manufactured glass, are sand, flints, and other fossil bodies of a stony and earthy texture; metals and semi-metals of all kinds previously prepared by calcination, or other operations; arsenic and zaffer which are prepared parts of a fossil, and all sorts of a fixt kind.

Among these substances there are some which are strongly reluctant to the vitreous fusion, and could scarcely alone be ever converted to glass, at least not by the heat of any furnaces, and yet are such as are most

capable of giving firmness and tenacity to that in which they are admitted, as also of being more copiously provided at a small expence. There are others, on the contrary, that vitrify in a much less heat than that commonly employed in the working of glass, and have likewise this attendant property along with their own proneness to vitreous fusion, that they accelerate and produce it in many of those that are otherwise more repugnant to it; and cause them, by their commixture, to vitrify in a greatly less degree of heat than they otherwise would. This property of promoting vitrification is called technically *fluxing* the bodies on which they so act, and on the proper application of this principle to practice, lies the main stress of skill in the art of compounding glass, as the savings in the original cost of the ingredients in time and in fuel, as well as the qualities of the glass produced, depend chiefly on the thorough intelligence, in this view, of the nature of the bodies proper to become ingredients of it. The next important relation in which bodies stand with respect to the composition of glass, is the effect they may have on its colour by their admixture; in order to destroy all kinds of which in some cases, and to produce them in others, ingredients are frequently added that are not otherwise necessary, as being no way subservient to the general view. This constitutes therefore the other great object of skill in the art of making glass; for the knowing properly how to take away all colour from the transparent white glass, and to impart any kind desired, to proper compositions on other occasions, is of the next great moment to the being able, by the most cheap and easy means, to procure a due vitrification.

According to the above specified intentions, in which the several substances serving for the materials of glass are used, they may be properly distinguished into three kinds, as making the *body*, *flux*, and *colorific matter*.

The substances which have been employed in forming the *body* of glass are sand, (by which is only to be understood the white kinds) flints, talc, spar, and several other stony fossils. All these vitrify of themselves too slowly to produce perfect glass by the degree of heat that can be applied to them when in larger masses;

which makes them therefore require the addition of those other kinds whose fluxing power may remedy this defect in them; while they, on the other hand, being of low price, and to be procured in unlimited quantities; and giving that hardness, strength, and insolubility, which cannot be had in any glass formed of other substances without them, are yet essential and indispensibly necessary ingredients in all kinds of manufactured glass.

The substances which are used as *fluxing*, ingredients in glass, are red lead, pearl-ashes, nitre, sea salt, borax, arsenic, the *scoria* of forges, commonly called *clinkers*, and wood-ashes, containing the calcined earth and lixivate salts, as produced by incineration. The presence of some of these bodies is always equally necessary with that of those which form the body, in all the compositions of manufactured glass. But the use of them, both with respect to choice and proportion, is greatly varied in different works, even where the same kind of glass is intended to be produced; as the general nature of them has never been hitherto understood by the directors of such works, and they have only implicitly followed the best receipts they could procure, carefully keeping them secret, when they happened, either by communication or their accidental discovery, to be possessed of such improvements as gave them any advantages over their fellow operators.

The substances which have been applied as *colorific matter* in manufactured glass, are extremely numerous and various; as all the species of metals and semi-metals, with many other mineral and fossile bodies, have been used for the producing some colour or other, and make a large field of speculative and practical knowledge. The art of staining glass, with all the variety of colours in the greatest degree of force and brightness is not, however, of so much importance, commercially considered, as the knowing how to banish and exclude, with ease and certainty, the colours which of themselves arise in most of the compositions for glass intended to be perfectly transparent and colourless. For this last purpose, nitre and magnesia are the principal substances employed in the manufactures of this country, and ex-

remely well answer the end, though not without enhancing the expence of the glass by the use of the first, and in a small degree injuring its transparency by that of the latter; as may be demonstrated by principles that are unquestionable in themselves, though wholly unknown to those who are practically concerned in these matters.

From these three kinds of substances, duly combined together by commixture and adequate heat, or, in some cases, from the two first only, all the sorts of manufactured glass at present in use are formed; the general manner of doing which is to reduce those kinds of bodies, that are in grosser masses, to powder; and then, all the ingredients being thoroughly well mixt together by grinding, and put into proper pots, to place them in a furnace where the heat is sufficient to bring them to a due state of fusion, in which they are to be continued till the vitrification be completed.

This proper degree of vitrification must be distinguished by the transparent and equal appearance of the matter, when a small portion is taken out and suffered to cool, except in the case of those sorts where the glass is not perfect; with regard to which a judgment must be made from their having attained or wanting that peculiar appearance which the particular sort is required to have. It may be proper to subjoin, that in all cases the vitrification is sooner and more easily made perfect in proportion as the ingredients are reduced to the state of a fine powder, and more intimately commixt.

CHAP. II.

Of the particular Nature of the Materials
used in the Composition of Manufactured
Glasses.

S E C T. I.

Of the Materials serving for the Body of Glass.

THE materials employed to give a body to glass are sand, flints, talc, spar, and some other stony and terrene fossils.

Sand is, at present, almost the only kind of substance which is used in this intention in the British manufactures of glass; and with great reason, as it extremely well answers the purpose, and does not demand the previous preparation of calcination that is necessary with respect to flints and other stones, and as it can be with certainty procured in any quantity demanded. The kind of sand most fit for making the white transparent kinds of glass is that brought from Lynn, in Norfolk, by the name of which place it is distinguished; and there is also another kind of this, but inferior, brought from Maidstone, in Kent. It is white and shining; and, examined by means of a microscope, appears to be small fragments of rock crystal, from which it does not seem, by any experiments, to differ in its qualities, and the glass formed of it may, therefore, properly be considered as made of crystal. The introduction of the use of it into the manufactures of glass in this country has almost wholly superseded that of flints, from which it no way differs in this application, but in the being some-

what slower in vitrifying, which makes it require in proportion a greater strength of flux and fire; but to compensate for this disadvantage, it is clearer in its own colour, and much freer from heterogeneous tinged bodies, which injure the colour of the glass, and frequently give embarrassment where flints are used. The sand requires no previous preparation for common and grosser purposes, especially where nitre is used, which burns out the sulphureous matter from any filth of the nature of animal and vegetable substances, and consequently calcines them to an earth no way injurious to the glass; but for nicer purposes, and where no nitre is used, it is proper to purify or cleanse the sand by washing, which may be thus done: Pour water upon it, and, having stirred them well about, incline the vessel immediately in such manner that the water may run off and carry with it the filth that will float in it; by repeating which a few times, the sand will be freed from all the heterogeneous matter that is lighter than itself. For coarse glass, other kinds of sand of a softer texture are used; as, besides the advantage of being cheaper, they are more easily vitrifiable than flints, and consequently make a saving in the *fluxing* bodies which are to be added to them.

Flints are the next important article in the substances which are used for forming the body of glass, and were indeed the only kind employed in larger works where any better sorts of glass were manufactured, before the use of the white sand excluded them in all places where it is to be conveniently obtained; since, for the reasons above given, it is a more eligible material, unless for experiments, or where very small quantities are required, in which case the calcined flints being more easily reduced to an impalpable powder, may possibly be more commodiously employed than the sand. Flints yet, however, continue to be used wherever the proper sand cannot be procured, at a reasonable charge, as the sole ingredient for forming the body of the better kinds of glass; since they are, in most places where they are naturally found, to be had in extreme great quantities, and the expence of calcining them does not enhance their whole cost to a degree beyond what the current

price of glass may bear. The goodness of flints, with respect to this use of them, must be distinguished by their clear transparent black colour, and all such as are marbled with brown or yellowish colour should be rejected for fear of iron, which frequently lurks in them under that appearance, and is very injurious to the colour of glass, if it get admission into it. Such should, therefore, be carefully picked out when found in parcels of the clearer sort; but if the greater part of any parcel appear so marked, it should not be used till trial be made, in a small quantity, whether the discolouring be owing to any substance detrimental to the colour of glass or not. It is always necessary that flints should undergo a calcination before they be used in the composition of glass, as well because they are not otherwise to be reduced to a texture, which will admit of their being powdered in order to their due commixture with the other ingredients, as because they are not susceptible of vitrification till a proper change be produced in them by *calcination*. This calcination must be performed by putting them into a furnace of a moderate heat, being first dipt in water, and continuing them there till they become entirely white, even to the most interior part, which will require a greater or less time, according to their magnitude, and the degree of heat of the furnace. When they are thus rendered white, they must be taken out of the fire, and instantly immersed in cold water, where they must remain till they be again cold; and then they will be found, if duly calcined, to be cracked and shivered into flaky pieces, and to become so softly brittle as to be easily reducible to powder. Some part will nevertheless be always found insufficiently calcined, which may be distinguished by their harder and more obdurate consistence, and they must be carefully separated in order to be re-calcined, as they will otherwise greatly retard and impede the powdering of the duly calcined parts. Those which are properly calcined must then be levigated by means of mills or other implements, according as the quantity or opportunity may make it expedient, and they will then be fit for using in the compositions for glass.

Talc of various species has been likewise used in the same intention as sand and flints, but seldom in large works. It sometimes requires a calcination in order to its due preparation for entering into the composition of glass; but neither so great a heat, nor the quenching in cold water, are necessary for bringing it to a proper texture to bear powdering. Some sorts of talc are much more quickly vitrifiable than others, and, fusing easily with either salt of tartar or lead, may therefore be used in default of flint, or sand sufficiently white. But, with respect to larger manufactures, the use of flints is more eligible, as they are to be procured in great quantities with more certainty, and will, in general, require much less flux and fire to bring them to a due state of vitrification.

Several other, both earthy and stony, fossiles, have been likewise used for forming the body of glass; and it has been observed, that most kinds of stony substances, which will scintillate or strike fire with steel, are vitrifiable within the degree that fits them for this purpose. But as they are neither used at present, nor promise to be any way advantageous in practice, as far as is hitherto known of them, I shall omit enumerating them, as being foreign to the purpose in hand, except with respect to two kinds. The one of these is called *maillon* by the French, and is found in great quantities, as an upper crust in many freestone quarries; and, as it may be used without any previous preparation, and is very quickly vitrifiable, may be serviceable, on some occasions, to those who may want to form glass or vitreous compositions, where this may be procured with more ease than any of the before-mentioned substances. The other is the white, round, semi-transparent, river pebbles, which vitrify very soon; and, if chosen colourless, make a very white glass; but they must be calcined, as the flint, by putting them into the fire till they be red hot; and then quench them in cold water, in order to bring them to a state fit to undergo powdering.

Kunckel confounds the calcined flints, and all other stones, used for making glass, under the name of sand, in his receipts; notwithstanding, he admits of a great difference in their readiness to be vitrified; as in the

case of calcined flints, and the softest kind of natural sand, where one hundred and forty pounds of salt are required to a hundred and fifty pounds of the calcined flints, and only one hundred and thirty pounds of salt to two hundred pounds of the sand.

SECT. II.

Of the Materials used as Fluxes in the Composition of Glass.

THE materials used for the fluxes in the composition of manufactured glass, are lead, pearl-ashes, nitre, sea salt, borax, arsenic, smiths' clinkers, and wood-ashes, containing the earth and lixivate salts as produced by incineration.

Lead is at present the most important flux in the British manufactures of what is called *flint glass*; but it must be brought, by previous calcination, to the state of minium, or what is called red lead. This, used in a due proportion, makes a tougher and firmer glass than can be produced from salts alone, and is yet procured at a very small expence. But all the glass formed of lead is tinged originally with yellow, and therefore requires the addition of nitre to burn and destroy the sulphur of phlogistic matter it contains, in order to bring it to a more colourless state, which addition of nitre enhances again the cost of glass so composed, that would otherwise be extremely low. There is another reason likewise for the addition of nitre, or some other salt, to operate as a flux in the glass compounded with lead, which is, that there may not be a necessity of using beyond a certain proportion of it: For, if glass have much lead in its composition, it will suffer a corrosion by the air, which gives a greyish dullness to its surface that is very injurious both to its beauty and utility. It is needless here to teach the manner of calcining lead, because it is done in works appropriated to that purpose, and is sold by the proprietors of these works at a cheaper rate than any particular persons could pretend to ma-

mufacture it for their private use. The perfection of red lead lies in its being thoroughly well calcined, which is best distinguished by its redness, inclining to crimson, and in its being pure, which may be judged of by the brightness of its colour. There is indeed no materials of a red colour cheap enough to adulterate it with, except powdered bricks, or some of the red ochres; and they would immediately shew themselves, in the vitrification of the smallest quantity, by the strong yellow tinge they would give the glass.

Pearl-ashes is the next leading article among the substances used as fluxes in glass, and they at present mostly supply the place of the Levant ashes, the barillas of Spain, and many other kinds, which were formerly brought here as well for making glass as soap. In the kinds of glass where perfect transparency is wanted, as in looking-glass plates, and all kinds of window-glass, salts are preferable as a flux to lead; and, consequently, the pearl-ashes become the principal matter of the flux; for, as all the lixivate or fixt alkaline salts of vegetables are the same for this purpose when pure, and those called pearl-ashes are purer than any other which can be provided at a moderate expence, the use of them is more expedient than of any other. This kind of fixt alkaline salts, called pearl-ashes, is prepared in Germany, Russia, and Poland, by melting the salts out of the ashes of burnt wood; and, having reduced them again to dryness, evaporating away the moisture, and calcining them for a considerable time in a furnace moderately heated. But, as they cannot be prepared with advantage in this country, (though in America they unquestionably might, and indeed are of late) and are to be had at a reasonable price by those who may have occasion to use them in making glass, I shall wave entering more particularly here into the detail of the process by which they may be best and most profitably produced, as not properly falling within the intention of this work. The goodness of pearl-ashes must be distinguished by the equal and white appearance of them; as it consists in their purity, and their having been calcined for a long space of time, of which the whiteness and equal appearance are marks, unless in the case of some

parcels that contain lumps of a bluish cast, produced by the calcination; which discolouring is not, however, any proof of their being bad; but any brownish cast in particular parts, or greyness in the whole, is a certain criterion of their not being good. This must, however, be confined to such as are perfectly dry, which can only well be on the opening the casks they are brought over in; for, if the air have access to them, they soon deliquiate and look brown or greyish, from a semi-transparency they acquire in that deliquiating state. There is one, and the most common adulteration, which is made in these salts, that is not easily distinguishable by the appearance; it is the addition of common or sea salt to them, which is sometimes copiously made. This is not, however, very detrimental in the application of them to the forming glass; but it is, nevertheless, a disadvantage considerable enough in large concerns, to buy one thing for another at six times its current price. As it is expedient, therefore, to know how to distinguish this fraud, the following method is proposed as easy and certain.

Take a small quantity of the salt suspected, and, after it has lain in the air so as to be a little softened but not melted, put it in a fire-shovel, and hold it over the fire where the heat is pretty strong. If it contain any common salt, a crackling, and, as it were, slight explosion will follow as the salt grows hot, which decrepitation is a certain mark of common salt whenever it is found.

The pearl-ashes require no preparation, except where extreme great transparency is required, as in the case of looking-glass, and the best window glass; in which cases a purification is necessary, in the manner which will be shewn in speaking of these particular kinds.

Nitre, in its refined state, in which it is commonly called salt-petre, has been formerly much used as a flux in the finer kinds of glass, and is now likewise employed in most compositions of the same nature. But this is a noted one, by those who are at all acquainted with the principles of the art, so much in the intention of a flux, as in that of a colorific ingredient, from its power of rendering glass colourless, by destroying the phlo-

giston in lead, or in any vegetable or animal matter which may tinge the glass, as we shall have occasion to observe more particularly in its proper place. As a flux, it is less powerful than fixt alkaline salts of vegetables; and, being dearer by much, its use would therefore be in proportion less expedient than that of pearl-ashes, if it were to be employed in this view only. The salt-petre that is used here is brought from the East-Indies, in the form of what is called crude nitre, and, in commercial language, rough nitre, in which state it is commixt with some proportion of common salt. It is refined by persons who make it their proper business, and bought for the purposes of glass-making in the state of salt-petre; on which account, it is unnecessary to give the process for refining it here. If it be obtained in crystals of such a size that the figure of them may be distinguishable, there is no hazard of any adulteration but what would be very apparent, as no heterogeneous matter can be made a proper part of such crystals, and, therefore, if they appear bright and colourless, the goodness cannot be doubted.

Sea salt is also frequently used as a flux in the making glass of various kinds, and it has a very strong power in promoting vitrification even in some obdurate bodies; but, used in a large proportion, it does not produce so strong and tenacious a glass as lead, or even the alkaline salts of vegetables, and is therefore only taken in aid of the others, when admitted as an ingredient. It should be brought to a dry state by *decrepitation*; that is, keeping it in a moderate heat till it ceases crackling, before it be put with the other ingredients into the fusing heat; otherwise, by the little explosive bursts of its parts, it will drive some of the powdered matter out of the pot. It must not, after such decrepitation, be again exposed to the air; for if it be, it will regain its former quality of crackling in a short time.

Borax is the most powerful flux of all the salts, or, indeed, of any known substance whatever; but, on account of its great price, can only be admitted into the composition of glass designed for looking-glass plates, or other purposes, where a considerable value can be set on the produce, or where the quantity wanted is

very small. It is brought from the East-Indies, under the name of tineal, and the refinement of it in a perfect manner is hitherto known but to few persons in Europe, who carefully keep it secret. The knowledge of it, however, is not important to the art of making glass, as it is always procured for that purpose in a refined state, and not used in very large quantities. The purity of it may be ascertained by the largeness and clearness of the crystals, for, when it is had in that state, it may be always concluded good. The previous preparation of borax for the composition of glass, is to calcine it with a gentle heat, which converts it to a flaky, feathery kind of substance, like calcined alum, after which it should be ground to powder, and is then fit to be commixt with other ingredients. This calcination of borax should be with a gentle heat, and in a very large vessel proportionably to the quantity, for it swells and rises in inflated bladders, so as to occupy a very great space.

Arsenic is also a powerful flux, but must not be added, nevertheless, in too great quantity; for, though when once vitrified perfectly, it greatly promotes the same change in other substances, yet, when added in a redundant proportion, it turns the glass milky or opaque, and keeps it in that state a considerable time before it will duly assimilate, from whence the due vitrification is greatly retarded, so as to occasion an intolerable loss of time and fuel. Though the glass in all such cases would become clear, if continued long enough in the fire, yet, on this principle of its slowness in vitrifying when added to compositions of glass in a large proportion, it is used for giving an opaque white colour to glass, as we shall see below.

Wood-ashes, by which is to be understood, likewise, those of broom, furze, or any other burnt vegetable, are used as a flux for the common bottle or green glass. The ashes must be taken in their original state, consisting of the calcined earth of the vegetable, and their lixivate or alkaline salt, as their virtue lies in their original manner of commixture; for this very extraordinary circumstance attends them, that though in their primitive state they vitrify easily, and act as a strong

flux to any of the vitrescible earths or stones; yet, if the salts be separated from the earth by solution in water, the earth from that time becomes extremely repugnant to vitrification, and though the same salts which were taken away from it, or even a much larger quantity be again added to it, it resists their fluxing power, and displays a nature entirely different from that which it appeared to have before its separation from the salts. There is no preparation necessary for these ashes in order to their entering into the composition of glass, except the sifting them to free them from all the fragments of charcoal, or unburnt parts of the vegetables employed in their production; but they should be carefully kept from damp and moisture, which would make the salts deliquiate and run off from the earth. The goodness of these ashes must be distinguished by their appearing free from impurities, and by their whiteness, and their abounding in salt is likewise a proof of their excellence, which may be examined, by maxing a lixivium of any known small quantity, and judging of its strength by its weight.

S E C T. III.

Of the Materials used to make Glass Colourless.

AS the substances used for producing the various colours in glass will more properly come in question when I treat particularly of that art, I will omit speaking of them here, and only at present inquire into the nature of nitre and magnesia, which are two ingredients used for rendering the glass colourless that is intended to be so; and which, indeed, is the kind much the most generally useful, and what makes the only subject of great manufactures.

The general nature of nitre, or salt-petre, has been before observed in speaking of it as a flux, and it only remains to explain that quality of it by which it operates in destroying the colour in those compositions of glass where it is used for that purpose. This quality is the power of ascending and supporting in a combustible

state of bodies which contain phlogistic and sulphureous matter, if they be brought in contact with it in a certain degree of heat, by which means such sulphureous or phlogistic matter is destroyed; or, in other words, it has the same combustible power with the air in making bodies burn till they be reduced to the state of a calx. In this intention, therefore, salt-petre is made an ingredient in those compositions for transparent colourless glass where lead is used as a flux; for such glass having otherwise a strong tinge of yellow from the phlogiston of the lead, requires, consequently, the destruction of the phlogiston, at least to a certain degree, in order to its being freed from this tinge. This operation of the nitre on the lead is most obviously apparent, if a piece of salt-petre be thrown into melted glass formed of lead; for a detonation or explosive effect immediately shews itself, and continues till the acid contained in the salt-petre be consumed.

The distinct knowledge of this principle clearly point, out in what compositions of glass nitre is necessary, and, in some degree, what the proportions may be in which it should be added to each kind, as such proportion must be regulated by the quantity of phlogiston to be destroyed; for, as has been before observed, considered merely as a flux, it is dearer than the pearl-ashes, without any advantage but the being somewhat more void of colour. This is obvious, as it is not only of double the price, but weaker in its action, unless where meeting with phlogistic matter in any of the other ingredients, it be deprived, as was above intimated, of its acid spirit, and converted, as it then will be, to exactly the same kind of fixt alkaline salt with the pearl-ashes themselves; but in the proportion of only one-third of its original weight. In glass formed of lead, therefore, the use of nitre is absolutely necessary, and, in glass of salts only, where the colour is to be entirely destroyed, and great transparency is wanted, as in the case of looking-glass, and several other kinds of plates, it is also requisite in a less proportion; for, though the appearance of any slight yellow tinge may be taken away by the use of the magnesia, yet that (for the rea-

son we shall see below) is always attended with a proportionable loss of the transparency.

Magnesia is the other substance employed for rendering glass colourless. It is a fossil that partakes of the nature of iron ores, but does not contain any considerable quantity of that metal, and sometimes only a very little. It is found in almost every country amongst other iron ores, and frequently also above the beds of lead-ore, where, indeed, the best seems to have been always found, probably from its being less replete with iron than such as is found in the beds of that metal. The hills near Mendip, in Dorsetshire, have particularly afforded extremely good. It is not of any peculiar shape or figure, but somewhat striated like antimony in its texture, and of a brownish black colour like foot. The marks of its being good is the deepness of the colour, and the being free from specks of a metalline appearance, or a lighter cast, and that should be particularly rejected which has spots of a reddish brown, or yellowish colour, as being signs of the presence of iron.

When fused with glass of any kind it readily vitrifies, and tinges the glass of a strong reddish purple colour, but not clear and bright. In consequence of this quality, it is used for destroying any slight yellowish or greenish tinge in glass that is required to be colourless, on the following principle: The three primitive colours of yellow, red, and blue, when mixed in due proportion, destroy each other, and produce the effect of grey in the case of opaque bodies, and of black in such as are transparent. Now, the tinge of magnesia in glass being purple, which is a compound of blue and red, and being added to the greenish or yellowish tinge of the glass, consequently destroys the appearance of it, especially the greenish, as the proportion of red in it is greater than that of the blue; but a proportion of black being produced, the glass is obscured in the same degree, though not so as to be perceptible to the eye, without comparing it with some other more pellucid. This is a reason for using the magnesia sparingly, or rather avoiding it entirely in those compositions of glass where great transparency is demanded, and for forming them of such ingredients as are most colourless, or may be rendered

so by the use of nitre. Magnesia requires to be well calcined in a hot furnace, and then to undergo a thorough levigation; for it ought to be in the state of an impalpable powder, in order to its perfect commixture with the other matter. It was formerly practised to quench the magnesia several times in vinegar after reiterated calcinations, with a view of freeing it from any iron that might be mixt with it; but this was needless, and is now entirely disused. Its application to the colouring glass, in which it is very efficacious for many purposes, we shall speak of in its proper place.

CHAP. III

Of the Instruments and Utensils employed in the Composition and Preparation of Glass.

THE instruments and utensils employed in the pounding and preparing glass are of two kinds, as they are subservient to two different purposes; *the levigation and commixture of the ingredients, and the fusion or vitrification of them.*

The instruments subservient to levigation, and the mixture of the ingredients, are horse or hand mills, mortars and pestles, and flat stones and mullars.

The horse or hand mills, may be such as are used for other purposes; but the stones should be of a very hard texture, in order that as little as possible of the matter of them may be abraded and commixt with the glass.

When large mortars are used for such ingredients as are not employed in a sufficient quantity to make it commodious to grind them in mills, they should be of cast iron, with pestles of the same, and should be carefully kept from rust. But for very nice purposes, where the quantity of the matter is small, mortars should be had of bottle or green glass, or of flint or agate, as also a stone and mullar of porphyry or agate, for levigating the calxes of metals, or other ingredients used in colouring glass.

Sieves or sieves of fine lawn should likewise be provided for sifting some of the levigated substances. They should be like those of the apothecaries and druggists, with a cover fitted to the upper part, and a box to the under, for preventing that waste of the matter which attends the sifting in the open air.

The utensils employed in the fusing or vitrifying the matter of glass are furnaces, with the proper iron work, pots for containing the compositions when put into the fire, with the iron instruments for shifting the matter from one to the other, in case of accidents; and for taking out small portions to judge of the progress of the vitrification, and the qualities of the glass.

The structure of the furnaces for preparing and working glass in large is so well and commonly known, that it is needless to enter into the detail of it here. Where smaller quantities are prepared, as in the case of coloured glass, or pastes in imitations of stones, the common wind-furnace, or the athanor of chymists, may be used; or a furnace may be made for this particular purpose, which may be constructed in the following manner:

Make out a circular area of one yard diameter, and let a cylindrical building be raised upon it of good stock bricks and coal-ash mortar, of the height of twelve inches. This cylinder must have an hollow area in the middle, of a round form, twelve inches in diameter; the rest of the space being filled with solid brick-work. But an opening must be left in the front at the bottom, which must be six inches broad and four high, for taking away the ashes; and it should likewise have an iron frame and door, like those commonly used for feeding the fire in furnaces, that it may be occasionally closed in order to check or extinguish the fire. This cylindrical fabric being raised to the height of twelve inches, a grate for bearing the fuel, composed of a strong iron ring with bars let into it, must be laid over the round hollow, and another cylinder, of the same diameter and thickness of wall, must be raised in like manner to the height of eight inches above the bars; but this should be done with Windsor bricks, and the mortar formed of Windsor loam, where they can be ob-

tained, and care should be taken likewise that the brick-work may have good hold of the rim of the grate. At the height of about five inches above the bars, a frame and door should be fixed for feeding the fire. The door should be about five inches high, and eight long, and should have a strong latch going across the whole breadth of it, by which it may be opened and shut. When the cylindrical hollow over the bars is thus carried eight inches high, a larger area must be taken of twenty-four inches diameter, and the brick-work must be carried up round it, in the same cylindrical manner as at first, for ten inches more, except that four iron doors and frames of the same form with those for feeding the fire must be fixt in the brick-work. The dimensions of these doors should be twelve inches high, and eight in breadth, and the lowest part of them should be level with the flooring made by the brick-work on enlarging the area of the cavity of the furnace; or, in other words, where the brickwork of this wider cylinder begins. These doors should be placed at equal distances from each other, and in such manner, that the other for feeding the fire may be exactly in the middle betwixt the two nearest to the front, and the chimney betwixt the others. A hole should be likewise left for venting the smoke into the chimney, which may be six inches broad and three high; and after this the brick-work may be brought together in the manner of an arch, till the whole cavity be covered. For the whole of this upper part, Windsor bricks and Windsor loam should be used, or, where they cannot be procured, such other as are most like them in their quality of bearing intense heat, without either being calcined or vitrified. The manner of using this furnace is too obvious to require explanation, it being enough apparent that the flooring in the enlarged cavity is intended for the pots or crucibles containing the matter, and the four doors for the more conveniently putting them in, and taking them out. When, however, they are to be placed in the furnace, it should not be on the parts before the doors, for fear the stream of cold air, or opening the doors occasionally, may crack them; but they should be conveyed through one of the doors to the opposite side, by

means of an iron peel, formed like those of the bakers, and put betwixt the doors on that side, by which means they will not only be much safer, but will be out of the way of impeding the operator from seeing what passes in every part of the furnace; and, by this means likewise, room may be found for many more pots and crucibles than could be introduced if the first four stood before the doors, and blocked up the entrance against any other. When this furnace is wanted for calcinations, or other operations that require less heat, the area of the cylinder should be made less by bricks formed of Windsor loam and sand, and adapted to the cylindrical figure of the cavity; which bricks may be easily put in, or taken out, by means of the four doors on the upper part, and that in the lower for feeding the fire. The dimensions of this furnace are calculated to answer the purpose of those who may engage in these matters for profit, and may be enlarged if there be yet occasion; but for such as meddle with them speculatively, and in the view of experiments only, they may be proportionably contracted, as being much larger than needful.

The pots for containing the melted matter of the glass should be formed of the clay used for making tobacco-pipes, or of the best potters' clay that can be procured. But as there is seldom any such clay found as will stand the drying and burning well, without the admixture of some earthy body, broken crucibles ground to powder, or, in default of them, white sand, or calcined flints, duly levigated, may be added. Near London, the tobacco-pipe clay, or the Sturbridge clay, with a fourth or fifth of ground crucibles or sand, are the best materials that can be used; but care should be taken to free the clay perfectly from stones or gravel, and to incorporate the ground crucibles or sand well with the clay. When the tobacco-pipe clay is used, it is previously calcined, and then ground to powder, and afterwards moistened with water, then well beat in the manner of mortar.

Small pots for making pastes or coloured glasses may be formed on a wooden mold, and should be slowly dried, and afterwards baked or burnt in a fire very gra-

dually increased to a strong degree, and then suffered to extinguish before the pots be taken out of the furnace. This may be done commodiously in a potter's kiln along with earthen or stone-ware; but the pots should be placed in the hottest part of the furnace. They otherwise may be burnt, where other conveniences are wanting, commodiously enough in the furnace above mentioned, and if intended to be used in such furnace, the largest may be six inches diameter, and ten or twelve inches in height. However, they must be formed a little conical or narrower at the bottom than the top, that they may be the more easily drawn from the mold, which need only to be a piece of wood turned into the form and dimensions of the cavity of the pot.

CHAP. IV.

Of the Preparation and Composition of the several kinds of White Transparent Glass now in use.

SECT. I.

Of the several kinds of White Glass, and their Composition in general.

THE several kinds of white transparent glass now in use in this part of the world, are the flint-glass (as it is here called) and the German crystal-glass, which are applied to the same uses and purposes; the glass for plates for mirrors or looking-glasses; the glass

for windows and other lights; and the glass for phials, and such kind of small vessels.

Of each of these kinds there are several sorts; some only differing in the particular manner composition and management of the directors of the works where they are manufactured, but alike in their price, and the uses to which they are applied; and others, which are allowedly inferior sorts, sold at cheaper rates, and employed accordingly for coarser purposes.

The several kinds of glass differ in the substances employed as fluxes in forming them, as well as in the coarseness or fineness of such as are used for their body. The flint and crystal, mirror, and best window-glass, not only require such purity in the fluxes as may render it practicable to free the glass perfectly from all colour, but, for the same reason also, either the white Lynn sand, calcined flints, or white pebbles, should be used. The others do not demand the same nicety in the choice of the materials; though the second kind of window-glass, and the best kind of phial, will not be so clear as they ought if either too brown sand or impure salts be suffered to enter into their composition. It is to be greatly regretted, that the important manufacture of glass should not be so cultivated and encouraged in Great Britain as to prevent totally the importation of the foreign; whereas, from the production of the sand, lead, and coals in our own country, we may make the best sorts of glass much cheaper than can be done elsewhere. We yet, however, take looking-glass plates of France, to the amount of a very considerable sum; some window-glass of the Dutch; and the German drinking-glasses for water, with gilt edges and other ornaments, and are now coming again extremely into fashion. The causes of this demand for foreign commodities, which are, or might be better and cheaper manufactured here, are various, and the displaying them not being a proper part of my business at present, I shall wave it, and only intimate, that the tax laid upon glass (against all the principles of good policy) has greatly corroborated them, as well as checked a growing exportation of some articles, which would probably in

time have been of very great consequence to our commerce.

S E C T. II.

Of the Nature and Composition of Flint Glass, and the German Cryстал Glass.

FLINT GLASS, as it is called in our country, is of the same general kind with what is in other places called crystal-glass. It had this name from being originally made with calcined flints, before the use of the white sand was understood, and, though no flints are now used in its composition, it retains still the name. This kind differs, however, from the German and other crystal-glass, in being partly formed of lead, whereas the fluxing bodies employed for the others are only salts or arsenic, and in having a white sand (which, as is said before, appears to be fragments of crystal) for its body. Instead of which, calcined flints, or the white river pebbles, or other such stones, are used for the crystal glass in other places; there being no sand of this kind of equal goodness found out of England, as far as is hitherto known.

The composition of flint-glass is, therefore, principally the white sand and lead, to which a due proportion of nitre is added, to burn away the phlogiston the lead, which otherwise imparts a strong yellow tinge to the glass, and to this is added, for hiding the remainder of the colour, a small quantity of magnesia; as also in some works a proportion of arsenic, to aid the fluxing ingredients. Flint-glass is not, however, a simple glass of lead; for where no other salts are added, yet the quantity of nitre used being considerable, and fluxing a proportionably quantity of the sand, it must be considered as a compound glass of salts and lead. But indeed it has been generally practised, to add some quantity of other salts to it, and diminish proportionably the quantity of lead otherwise necessary. The quantity, though great in the glass made some time ago, seems to be much diminished in that manufactured

lately, at least in some works, as appears from the small weight and transparency of what is now to be met with, as well as from the vessels being blown much thinner, and of less substance, than the glass in which lead abounds could well bear to be. The admission of lead into glass renders such glass less hard and transparent than that made of salts only. But there is in glass of lead a power of reflecting the rays of light, of the same nature with that of diamonds and topazes, and gives a lustre and brilliant appearance to vessels of a round figure, not found in the mere glass of salts, where the too great transparency, and want of play, occasion a poorness or deadness in the look, when seen by the other; and this likewise extends itself, in some degree, to the appearance of liquors contained in them. For polygonal vessels, however, or those cut with flat sides, or such as are decorated with flowers, or other ornaments cut in them, or with gilding, the glass of salts is preferable, as may be observed in the instance of those brought from Germany. This must not, nevertheless, be extended to such pieces as are cut with a great number of angles for the parts of chandeliers, or other purposes where the play of the light is wanted; for in all other cases, the glass formed with lead again takes place of the other, as producing a greatly stronger and more beautiful effect, for the reasons before given.

It appears from what has been said, that flint-glass may be, as in fact it is, formed of various compositions, by altering the quantities of lead and nitre, and adding equivalent proportions of other salts or arsenic; in consequence of which, savings may be made in the expence, and a difference will arise in the hardness or softness of the glass. For the more the quantities of nitre or other salts are increased, and that of the lead diminished, the more hard and firm the texture of the glass will be, and so *vice versa*. I will therefore give a recipe for the composition of a glass, according to each of the several manners, in which the proportions of the ingredients may be properly varied, and distinguished likewise, in each case, what the absolute and comparative qualities of the glass produced will be, and with respect to the comparative expence, the quantities of the several in-

redients being thus stated, it will be very easy for those who are acquainted with the market price of them to make a computation.

No. 1. *Composition of the most perfect kind of Flint Glass.*

“ Take of the white sand one hundred and twenty pounds, of red lead fifty pounds, of the best pearl-ashes forty pounds, of nitre twenty pounds, and of magnesia five ounces.”

If this composition be fused with a very strong fire, and time be given to it, a glass will be produced that will have the play of the best flint-glass, and yet be hard and strong. It is not so cheap as the compositions below given, where arsenic or common salt is introduced, or where more of the pearl-ashes are used; in either of which cases, savings may be made by diminishing proportionably the quantities of nitre. But the qualities of this glass will be found to come nearer to the standard of perfection; which is to unite the lustre and hardness together in the greatest degree they are compatible with each other.

If this composition be, however, desired to flux with less heat and quicker, a pound or two of arsenic may be added, which will be found effectually to answer the purpose.

No. 2. *Composition of Flint Glass with a greater proportion of Salts.*

“ Take of sand one hundred and twenty pounds, of the best pearl-ashes fifty-four pounds, of red lead thirty-six pounds, of nitre twelve pounds, and of magnesia six ounces.”

This will require much the same fire as the other, but will be harder in its texture, and have less of the refractive play of the light; it is, however, a very good composition of glass, and comes nearer to the kind now made, though I imagine the proportion of lead is still more diminished in some I have seen than here. If it be desired to be made more yielding to the fire, arsenic may be added, as is directed for the preceding, or the

quantity of sand may be lessened, but in that case the glass will be softer and weaker.

No. 3. *Cheaper Composition of Flint Glass with Arsenic.*

"Take of white sand one hundred and twenty pounds, of the best pearl-ashes thirty five pounds, of red lead forty pounds, of nitre thirteen pounds, of arsenic six pounds, and of magnesia four ounces."

This glass will require a considerable time in the fire to become clear, and must not, if it can be avoided, be strongly urged at first; for the arsenic is apt to sublime away, if the heat be violent before the other ingredients run into fusion so as to detain it. It is well, therefore, to mix a considerable proportion of glass which has been wrought before, and is to be manufactured over again with this composition when it is used, which, running sooner than the new mixt ingredients, will take hold of the arsenic and fix it. This composition should however be afterwards fused with a considerable heat, and continued in that state till the milky appearance of the arsenic, which it will sometimes retain for a long time, be entirely gone. For notwithstanding this apparent reluctance to perfect vitrification, the arsenic never fails at length to become very transparent glass, and even to contribute greatly to render the other ingredients so likewise. This glass will not be so hard as those of the above compositions, but it will be very clear, and may be employed for the formation of large vessels where a sufficient thickness can be allowed to give them strength.

No. 4. *Cheaper composition of Glass by means of common Salt.*

"Take the proportions of the other ingredients given in the last, and, omitting the arsenic, add in its stead fifteen pounds of common salt."

This will be more brittle than the last, and therefore cannot be recommended, unless for the fabrication of such kind of vessels or other pieces where the strength is of little moment.

No. 5. *Cheapest composition of Flint Glass, by the addition of Arsenic and common Salt.*

“ Take of the white sand one hundred and twenty pounds, of red lead thirty pounds, of the best pearl-ashes twenty pounds, of nitre ten pounds, of common salt fifteen pounds, and of arsenic six pounds.”

This glass will fuse with a moderate heat, but requires time, like the last, to take off the milky appearance of the arsenic; it is yet softer than the last, and may therefore be deemed the worst kind of flint-glass that can be made, preserving the appearance of good glass to the eye, which it will have equally with any other, when properly managed.

No 6. *Composition of the best German Crystal Glass.*

“ Take of the calcined flints, or white sand, one hundred and twenty pounds, of the best pearl-ashes seventy pounds, of salt-petre ten pounds, of arsenic half a pound, and of magnesia five ounces.”

If the pearl-ashes be pure and good, this glass will equal the best of this kind that ever was made. Borax has been frequently used also in the compositions for this sort of glass; but its great price, without any equivalent advantage, will deter from the employing it in large manufactures, as there is no sort of transparent glass in common practice, that of which looking-glass plates is made excepted, can bear the expence of it.

No. 7. *Cheaper composition of German Crystal Glass.*

“ Take of calcined flints, or white sand, one hundred and twenty pounds, of pearl-ashes forty-six pounds, of nitre seven pounds, of arsenic six pounds, and of magnesia five ounces.”

This composition requires a long continuance of heat, on account of the arsenic, for the reason before given. It produces a glass equally, or more transparent and colourless than the preceding, but somewhat more brittle. The arsenic is, however, so disagreeable an ingre-

dient, from the deleterious qualities of the fumes, which will necessarily rise copiously till the fusion of the other ingredients check it, that, where the advantage is not more considerable than the saving arising from the difference of these two recipes, it is scarcely worth while to submit to the inconveniencies of it.

SECT. III.

Of the Nature and Composition of the Glass proper for Plates for Mirrors or Looking-glasses..

THE glass for forming the looking-glass plates in perfection, is the most nice and difficult kind to manage of any whatever, there being no latitude, with respect to several of the qualities; as there is in the case of flint-glass, without its goodness being really impaired. These qualities are to be entirely transparent and colourless, to have as little power of refracting the rays of light as possible; to be entirely free from bubbles, specks, and flaws, and to be fusible with a moderate heat. Hardness of consistence is of less consequence in this kind of glass than in the flint, though it is an additional excellence, as far as it may be had along with the other qualities, since the plates may, in that case, be wrought thinner with the same degree of strength, which is a considerable advantage to mirrors made of them.

The white sand is the proper ingredient for forming the body of this kind of glass, as well as of the flint, and the principal part of the flux should be the fixt alkaline salt of vegetables, which the pearl ashes will best furnish when duly purified. This salt must, however, be aided by borax or common salt, in order to facilitate the fusion, and prevent the glass from stiffening in that degree of heat in which it is to be wrought into plates. Lead is by no means a proper ingredient in the composition of this kind of glass, on account of its augmenting the refracting power, and for the same reason arsenic, which has the like effect, though in a much less

degree, should be either omitted, or but sparingly used. The sand should be carefully cleansed for this use, by the means above directed for that purpose, p. 165, and the borax should be first calcined, and then rubbed to powder. The pearl-ashes must likewise be purified for this use, which may be done in the following way.

Manner of purifying the Pearl-ashes.

“ Take any quantity of the best pearl-ashes, and
 “ dissolve them in four times their weight of water
 “ boiling, which operation may be best performed in a
 “ pot of cast iron. When they are dissolved, let the
 “ solution be put into a clean tub, and suffered to re-
 “ main there twenty four hours or longer. Let the
 “ clear part of the fluid be then decanted off from the
 “ dregs or sediment, and put back into the iron pot, in
 “ which the water must be evaporated away till the
 “ salts be left perfectly dry again. They should then,
 “ if not used immediately, be kept in stone jars well
 “ secured from moisture and air, till such time as they
 “ are wanted.”

Great care should be always taken, in this treatment of the salts, to keep the iron pot thoroughly clean from rust, which would give a yellow tinge to the glass, not to be removed without greatly injuring it.

No. 1. Best composition of Glass for Looking-glass Plates.

“ Take of white sand cleansed sixty pounds, of pu-
 “ rified pearl-ashes twenty-five pounds, of salt-petre
 “ fifteen pounds, and of borax seven pounds.”

This composition should be continued long in the fire, which should be for some time strong, and afterwards more moderate, that the glass may be entirely free from bubbles before it be worked. It will be entirely clear of all colour, unless in case of some accident; but if any yellow tinge should, nevertheless, unfortunately infect it, there is no remedy, except by adding a small proportion of magnesia, which should be mixed with an equal quantity of arsenic, and after their being put into

the glass, giving it a considerable heat again, and then suffering it to free itself from bubbles in a more moderate one as before. If the tinge be slight, an ounce of magnesia may be first tried, and if that prove insufficient, the quantity must be increased; but the glass will always be obscure in proportion to the quantity that is admitted, though perhaps not in a degree that may prevent it from passing currently with those who do not examine with great strictness. This composition is not to be made without expence at the times when borax is dear; but the great price which looking-glass plates, particularly such as are large, bear, will very well allow it; or even the adding a greater quantity of borax, when there is occasion to have the glass run more easily, and roll in a less degree of heat.

No. 2. *A cheaper Composition for Looking-glass Plates.*

"Take of the white sand sixty pounds, of pearl-ashes twenty pounds, of common salt ten pounds, of nitre seven pounds, of arsenic two pounds, and of borax one pound."

This glass will run with as little heat as the former, but it will be more brittle, and refract the rays of light in a greater degree. It is, therefore, worse than the other in a greater degree, than is balanced by the saving in an article where the cost of the materials is not considerable in proportion to the return; it being the work and skill, and not the prime expence of the ingredients, that make the high price of looking-glass plates. It would be consequently unpardonable, while they continue to be sold at the present dear rates they bear in this country, to impair the quality of the glass, for the sake of a trifling saving out of the original price of the materials.

SECT. IV.

Of the Nature and Composition of Window Glass.

IN order to have window-glass in the utmost perfection, the same qualities and treatment are required as for the looking-glass plates, and the same kind of glass is therefore used for lights where the expence can be allowed. But as that is only done in extraordinary cases, inferior kinds of various rates of price are wanted for more common purposes, where not only the cost of grinding may be saved, but even the glass itself afforded cheaper, on account of its composition. The best of these kinds is called *crown-glass*, the composition for which may be as follows, the ingredients being previously prepared in the same manner as for looking-glass.

No. 1. *Composition of Crown or the best Window Glass.*

“ Take of white sand sixty pounds, of purified pearl-ashes thirty pounds, of salt-petre fifteen pounds, of borax one pound, and of arsenic half a pound.”

This will be very clear and colourless, if the ingredients be good, and will not be very dear. It will run with a moderate heat; but if it be desired to be yet more fusible and soft, half a pound, or a pound more of arsenic may be added. If the glass should prove yellow, the magnesia must be used as above directed for the looking-glass.

No. 2. *Composition for a cheaper kind of Window Glass.*

“ Take of white sand sixty pounds, of unpurified pearl-ashes twenty-five pounds, of common salt ten pounds, of nitre five pounds, of arsenic two pounds, and of magnesia one ounce and a half.”

This will be inferior to the above kind, but may be improved, where desired, by purifying the pearl-ashes. This operation will not only free them from the remain-

ing part of the earth of the ashes they were extracted from, (which is apt to give a small degree of opacity to the glass, as it will not vitrify in this state) but renders them also liable to impart a yellow tinge to the glass; and, therefore, where the goodness of such ashes is known by trial, an ounce of the magesia, or perhaps more may be spared.

No. 3. *Composition of Common or Green Window Glass.*

"Take of white sand sixty pounds, of unpurified pearl-ashes thirty pounds, of common salt ten pounds, of arsenic two pounds, and of magnesia two ounces."

This is a cheap composition, and will not much appear green, nor be very deficient in transparency.

No. 4. *Cheapest composition of Common or Green Window Glass.*

"Take of the cheapest kind of white sand one hundred and twenty pounds, of unpurified pearl-ashes thirty pounds, of wood-ashes, well burned and sifted, sixty pounds, of common salt twenty pounds, and of arsenic five pounds."

This composition is very cheap, and will produce a glass with a greenish cast, but greatly superior to what I have frequently met with; though nothing that will at all answer the end can be well prepared at less expence.

SECT. V.

Of the Nature and Composition of the Glass for Phials.

THE glass of which phials for the use of apothecaries, ink-bottles, and many other such small vessels are made, is a kind betwixt the flint-glass and the common bottle or green glass; a very good sort of which may be thus prepared.

No. 1. *Composition of the best Phial Glass.*

“ Take of white sand one hundred and twenty pounds, of unpurified pearl-ashes fifty pounds, of common salt ten pounds, of arsenic five pounds, and of magnesia five ounces.”

This will be a very good glass for the purpose, and will work with a moderate heat, but requires time to become clear, on account of the proportion of arsenic; when, however, it is once in good condition, it will come very near to the crystal-glass.

No. 2. *Cheapest composition of Green or Common Phial Glass.*

“ Take of the cheapest kind of white sand one hundred and twenty pounds, of wood-ashes, well burnt and sifted, eighty pounds, of pearl-ashes twenty pounds, of common salt fifteen pounds, of arsenic one pound.”

This will be green, but tolerably transparent, and will work with a moderate fire, and vitrify quickly with a strong one.

C H A P. V.

Of the Commixture of the Ingredients for composing Glas, and the manner of the Fusion and Coction of the several Compositions of the White Transparent Kinds, in order to their being duly incorporated and vitrified.

S E C T. I.

Of the Commixture of the Ingredients for the several Compositions of White Transparent Glas.

THE commixture of the ingredients for making glass must be performed by different methods, according to the nature of the ingredients that enter into the different compositions.

When sand and fixt alkaline salts, whether in form of pearl-ashes, or of such as are extracted from them, or any other ashes of vegetables, are used together, they ought to be thoroughly mixt, by grinding them in a plate free from damp. When they are so mixt, they should be put into a proper calcining furnace, and there continued in a moderate heat for five or six hours, being in the mean time frequently turned over and stirred about, by means of a proper rake, and at the end of that time taken out of the furnace, and either immediately used, or kept where no moisture can have access to them till wanted. The matter in this state is called *frit*, and may be converted into glass without further preparation than

being broken into gross powder before it be put into the pots, unless where other ingredients are to be added to it, in which case the following methods may be pursued.

When nitre is to be added to the frit, it should be after the calcination, and if it be well powdered, it must be mixed with the frit, without their being ground together.

If arsenic be also used, it should, being previously well levigated, be mixed with the nitre at the time that it is to be powdered, and they may be then added together to the frit. But if no nitre be used, it should be ground with some pounds of the frit, or rather with some of the salts of which the frit is made, and then put to it.

In the case of the flint-glass, when large proportions of lead and nitre are admitted into the composition, or in other cases of soft glass, where very powerful fluxes are used, the calcining the frit is dispensed with, and the sand, alkaline salts, lead, nitre, and also arsenic, if any be used, are thoroughly mixt together by grinding. But if a calcined frit be used, the matter, after it has undergone that operation, and been grossly powdered, must be put into the pot with the other ingredients in that state, they being previously well commixt together by grinding.

If borax be used with the frit alone, it should be ground with a small part of it, and then mixt with the rest. But, if other ingredients are to be added, it may be ground with them. It should, however, be always first calcined, that is, placed in a moderate heat, till the ebullition it makes at first be over, and it be left in a dry state.

When common salt is used in the composition of glass where the frit is prepared, it may be added to the alkaline salt and sand when they are to be ground together, and calcined along with them, which will spare the trouble of the decrepitation, mentioned in p. 165, to be necessary. The salt must otherwise be put into a proper vessel, and continued in a gentle heat till it ceases the crackling it will for some time make; and, if it be not used immediately, it must be carefully kept

from all moisture, even that of the air. When no frit is previously made so as to afford an opportunity of calcining the salt with it, being first decrepitated, it may be mixt with any of the other ingredients, but must not be suffered to attract any moisture, otherwise it will crackle and decrepitate again in the pots, and waste the matter, by dissipating it with the numberless little explosions it will make.

Magnesia, when admitted into the composition of glass made of frit without any other addition, being well levigated preparatorily, should be intimately mixt by grinding with same pounds of the frit, and then put into the pots along with the rest. But where lead, salt-petre, or other ingredients are to be added, it may be mixt with them when they are ground, and then put to the frit. If no frit be prepared, it may nevertheless be mingled with any of the fluxing ingredients, and so commixt with the whole mass.

SECT. II.

Of the manner of Melting and Fusing the several Compositions, in order to their conversion into Glass, with the means of judging when the Vitrification is perfect.

THE materials being all prepared and duly mixt, the matter must be put into the pots, and urged to fusion, by a heat proportioned to the strength of the flux in the composition; and this must be continued till the whole mass become one uniform fluid, and have acquired the qualities necessary in that particular kind of glass which is intended to be produced. There is an attention to another object, however, required in the mean time, which is, the taking off the scum and foulness that will arise on the glass in the action of the ingredients on each other, and the coction of the matter. This is to be done by means of proper ladles, and should be effectually performed before the glass be wrought; otherwise it will be so fouled by this substance, as to be rendered of very little value. This matter is called *sandover*; and is sold to the colourmen, who dispose of

it to the potters, and they use it in the compositions of their glazings.

The exact time for keeping the several compositions of glass in fusion, in order to their perfect vitrification, can by no means be settled by rule. For there is so much variation in the disposition of different parcels of materials of the same kind to vitrify, and likewise so great an uncertainty, with respect to the degrees of heat maintainable even in the same furnace, that it must be left to the judgment of the operator. But where the power of the flux is weaker, as may be gathered from the nature and proportion of the ingredients in the composition, or where the heat is less intense, a greater time will necessarily be required than in the case of stronger fluxes, and brisker fires. No damage can, however, accrue from allowing a longer fusion than may be necessary to give the glass the appearance of being perfect, except the loss of time and consumption of fuel; for, with respect to the white transparent glass, it is always improved in its hardness and clearness by a longer coction.

In order to examine whether the glass have attained to its due state of vitrification, an iron rod, of which the end should be bright, or at least entirely free from rust, must be dipt in the melted matter; and what adheres to it should be first tried, with respect to its ductility or readiness to suffer itself to be drawn out in long threads; and if this quality be found in it to a sufficient degree, being suffered to cool, it should be carefully inspected, to form a judgment of its colour and clearness. If it be transparent, colourless, and free from all specks and bubbles, it may be concluded perfect, and fit to be wrought. But if it want these marks, more time must be given, according to the degree of the defectiveness; and, after a reasonable allowance of such time, it must be examined again by the same means; and, if not yet perfect, a further time must be given, and then the same trial made again. If, nevertheless, after all reasonable allowance of time, and the application of a strong heat, which should be raised as high as can be admitted conveniently, without detriment to the other operations that may be carrying on in the

same furnace, the glass yet appear faulty, the means below advised must be called in aid, in order to remedy the defects, either in the materials themselves, or the means of their composition.

SECT. III.

Of the means of promoting and accelerating the perfect Vitrification of the Ingredients, when the composition proves defective in that point; with the means of removing any yellowish or greenish Tinge that may arise.

IF, after the treatment above advised, sufficient time and heat having been given, according to the nature of the composition, the glass will not be brought to run into one equal fluid mass, but appear yet turbid and milky, or to abound in bubbles after some abatement of the fire, it must be concluded that the flux is too weak. An additional quantity of the fluxing ingredients, mixt together in the same relative proportion as at first, must be therefore put into the pot to the melted mass, but gradually, lest any sudden ebullition may swell the matter, and force it out of the pot. The proportion of the whole of this additional quantity must be regulated by the appearance of what may be wanted from the backwardness of the vitrification in the glass; but it is better to try a smaller quantity first, because more may easily be added, if found necessary, and an excess, on the other hand, injures the qualities of the glass, and in the case of salts cannot be rectified, unless by a long continuance of the fusion. There is, moreover, this further reason for trying only a small quantity at first, that frequently much less will answer the end than the appearance may seem to make necessary.

It is the practice of some, when the vitrification will not go forwards, to have recourse to the following expedient: They take four, or perhaps six ounces of arsenic, and mix with it an ounce of magnesia, and, wrapping them tightly in a piece of paper of several doubles, they fasten the mass to the end of their iron, and plunge

it down to the bottom of the pot, where, the substance of the paper being destroyed, the matter is left. This will frequently succeed, and the glass will grow clear first towards the bottom, and soon after quite to the top, and gain the perfect state of vitrification. The magnesia, nevertheless, however it may promote the fusing power of the arsenic, does not seem a very proper ingredient in all cases; for where there is no yellow tinge in the glass, it will necessarily impart a purplish cast, which, though perhaps in too slight a degree to be easily distinguished on a common inspection, is nevertheless an imperfection, and would shew itself if the glass were to be compared with such as was absolutely colourless. I should think it therefore better to join two or three ounces of calcined borax with the arsenic, which would answer the end without any kind of injury to the glass, and would not greatly enhance the expence when it is premised how considerable a return a pot of glass makes when worked off.

When the glass appears perfect in other respects, but is found to have a green or yellow tinge, such tinge may frequently be diminished by the addition of one or two pounds of nitre, if none, or but a small proportion have before been admitted into the composition. The nitre, in this case, should be fluxed with some frit, or with some other glass of the same kind with that in the pot, before it be put to the other ingredients. This is requisite in order that it may the readier mix with the matter, and not to be partly blown out of the pot by the ebullition it would make in consequence of the water contained in its crystals, or partly swim on the surface, as would happen if it were put in crude, without being preparatorily heated or mixed with any other body. But if this fail, or remedy only in part the fault, recourse must be had to the magnesia, to which may be advantageously added two or three ounces of arsenic, and they may be conveyed into the pot by the means above directed, which prevents the powders from floating on the surface of the melted matter, where the arsenic would soon sublime away and take no effect.

C H A P. VI.

Of the composition and treatment of the common Bottle or 'Green Glass.

THIS kind, excepting the beauty of colour and transparency, is the most perfect glass at present manufactured, and, with respect to its utility, is also equal in importance to any other. It is formed of sand of any kind, fluxed by the ashes of burnt wood, or of any parts of vegetables. The ashes must not have the salts extracted from them, but must consist of them and the calcined earth of the vegetable substances whence they are produced. This earth, though when once separated from the salts formed along with it in the incineration, it becomes absolutely refractory to vitrification, and resists not only the small salts which were taken from it, but even the strongest fluxes, yet conjoined with these salts, in the manner in which it is originally produced in the incineration, it not only vitrifies perfectly itself, but even acts as a flux on sand; for on the mixing sand with the entire ashes, a much greater proportion will be converted into glass than would be by the proportion of salts contained in the ashes if used alone without the earth. In general, the bottle-glass is only compounded of these two ingredients, sand and wood ashes; but where the scoria or clinkers of furnaces or forges can be obtained in sufficient quantity, they may be added with great advantage, as a much less proportion of wood-ashes will become necessary, and the good qualities of the glass be rather improved than impaired. The scoria to be obtained at large foundries are very proper for the purpose, or those from any other such works where large and strong fires are used. The particular composition of this glass may be as follows, but the proportions here given suppose the softest sand, to procure which care should be taken, as a

great saving is thence made in the quantity of wood-ashes necessary,

Composition of Green or Bottle Glass.

“ Take of wood-ashes two hundred pounds, and of sand one hundred pounds : mix them thoroughly well by grinding together.”

This is the due proportion where the sand is good, and the wood-ashes are used without any other addition ; but there are instances of sand of so kindly a nature for vitrification, that a greater proportion of it may be added.

Composition of Green or Bottle Glass, with the addition of Scoria or Clinkers.

“ Take of wood-ashes one hundred and seventy pounds, of sand one hundred pounds, and of scoria or clinkers fifty pounds ; mix the whole well by grinding them together.”

The clinkers should be well ground before they be used, if they admit of it ; but frequently they are too hard, and in that case they should be broken into small bits as can be done conveniently, and mixt with the other matter without any grinding. The harder they are, the less material will be the powdering them, as they will the sooner melt of themselves in the furnace and consequently mix with the other ingredients.

The general manner of fusing and converting this composition to glass is the same as in the other kinds, as are also the means of judging when the vitrification is perfect, and the remedy of the defect when the first composition will not produce it, except with respect to colour, which is, in the case of this kind of glass, entirely out of question. When clinkers are not to be had in sufficient quantity to allow of their being used in the general composition, it is well however to have some quantity to employ occasionally when the vitrification fails ; for the adding such a proportion of them as may appear necessary, with an equal part of wood-ashes, will answer the purpose much better than the ad-

tion of more wood-ashes alone, where the flux is found too weak, as will happen sometimes from the great variation in the different parcels, as well of the ashes as sand.

CHAP. VII.

Of Coloured Glafs.

SECT. I.

Of the general Nature of coloured Glafs, and of the several Compositions proper for receiving the Colours, in order to the forming Glafs, or Pastes, in imitation of precious Stones, with the qualities attendant on each.

THE glafs which is intentionally tinged with colours, may be divided into three kinds; the *white opake* and *semi-transparent glafs*; the *transparent coloured glafs*; and the *semi-transparent or opake coloured glafs*.

The *white opake glafs*, as also some transparent kinds, are principally used for making small vases, toys, and some sort of useful vessels, as cream-pots, &c. in imitation of China-ware of any kind, of which we shall speak below. It is also frequently employed as a white enamel for grounds, by painters of enamel dial-plates, snuff-boxes, and other such pieces as have not occasion to pass several times through the fire in order to their being finished.

The composition of white opake and semi-transparent glafs is very various, as any kind of colourless glafs may be made the body of such, and the tinge may be

given by calcined tin or antimony, also by arsenic, calcined hartshorn or bones, and several other substances.

The *transparent glass, tinged with colours*, is likewise of different kinds, as the body or ground may be transparent colourless glass of any of the compositions above exhibited. But it is commonly distinguished into two sorts only, the one called *coloured glass*, and the other *pastes*; the reason of which distinction lies in this:—The chief design of all coloured transparent glass being the imitation of precious stones, the qualities of such glass, when perfect, are to be very clear and transparent; to be free from all colour but the proper tinge, and to be very hard and tenacious in their texture. But these qualities being not to be had, except in glass that is very difficult to be melted, and requires a long as well as an-intense heat, both to its own mature vitrification and that of the bodies added to give the colour to it, it became inconvenient to those who prepared these kind of compositions in small quantities to maintain such strong fires, and therefore softer compositions were sought for, that would run with the heat of common small furnaces, and would likewise be brought to perfection in a much shorter time. These compositions were therefore called *pastes*, to distinguish them from the harder glass, which retained its proper appellation.

The glass most proper for the imitation of precious stones, where the hardness, which is a most valuable quality in such as is intended for mock jewels, that are exposed to much wear, is wanted, is a perfect glass of salts, in which no more flux is admitted than merely what may be necessary for the complete vitrification of the glass and tinging substances; but it should be absolutely free from every kind of tinge, except that which is intended to be given it.

The kind most proper for forming *pastes* is a mixture of lead and salts, which will run easily and vitrify in a short time, the metalline or other bodies that are employed for tinging it. But in order to make it yet more fusible, without having so large a proportion of lead as may make the texture of the glass too tender and brittle, arsenic and borax may be admitted into

composition. Besides the forming imitations of coloured stones, there is yet another purpose to which this kind of glass is peculiarly adapted, which is the making mock diamonds and topazes, that cannot be so well counterfeited by any other composition, as the lead, according to what was before observed, gives a very extraordinary refracting power to the glass, of which it is an ingredient. This sort might seem to belong to the class of the white transparent kinds of glass before treated of; but as the application of that kind of composition, which renders it properly a paste according to the above distinction is confined to the imitations of imitating gems, it is more properly introduced amongst the others with which it has a common denomination.

The semi-transparent coloured glass may have for its body either the compositions of the harder kinds, or of pastes, and it is principally applied to the imitation of the semi-transparent stones, as *lapis lazuli*, *malachite*, *jasper*, *agate*, *opal*, or such others. The manner of composing them is much the same as that of the transparent kinds, except the adding some opaque white body, which will endure the fusion of the glass without being vitrified, at least long enough to suffer it to be worked into the proper form. But the management of those of this kind, which are compounded of a variety of colours, is much more difficult than that of the transparent sorts, which is most probably the reason why they are so little in use, though some of them have a very beautiful effect for purposes they might be equally well applied to with the genuine stones.

SECT. II.

Of the nature and preparation of the substances used for tinging Glass.

THE substances employed for tinging glass are, for the most part, metallic and other fossile bodies; or indeed all are so, except tartar, which has been added to some compositions. The metals themselves make

the principal part, and, properly treated, will produce all the colours, except a perfect blue. But for cheapness and expedience, the semi-metals, and preparations from other fossile bodies, are sometimes admitted in the place of them, particularly with respect to yellow, where antimony supplies the place of silver.

The substances that have been used for producing an opaque whiteness in glass, are calcined tin, (commonly called putty) calcined antimony, arsenic, calcined horns or bones, and sometimes common salt.

The substances employed for red, are gold, iron, copper, magnesia, and antimony.

The substances employed for blue, are zaffer and copper.

The substances that have been employed for yellow are silver, iron, antimony, and magnesia, with tartar.

The substances employed for greens, are copper, Bohemian granata, and those which will produce yellow or blue.

The substances employed for purple, are all such which will produce red and blue.

The substances employed for orange colour, are antimony, and all those which will produce red and yellow.

The substances employed for black, are zaffer, magnesia, copper, and iron in various combinations.

The particular nature and preparation of several of these substances having been before given in the first volume of this work, I shall avoid repeating them here, and only refer to the pages where what relates to them is to be found. This preparation of calcined tin is to be found in page 199;—of calcined antimony 200;—of gold 203;—of silver 206;—of copper 206;—of iron 209. The nature of zaffer is explained 201;—arsenic as a white colorific 200;—magnesia 201;—of antimony as a yellow 210;—of antimony vitrified into a red glass 211;—and of tartar 212.

The Bohemian granata requires no other preparation than to be well pulverized.

S E C T. III.

Composition of hard Glass and Pastes proper for receiving Colours.

THOUGH almost every kind of transparent colourless glass will admit of being tinged, yet there are, as was observed before, some compositions that are more peculiarly adapted to the purposes for which the colourless glass is intended, either by their hardness and tenacious texture, or their being more easy to be wrought by those who manufacture them, from their requiring less heat to fuse them, and fluxing the colorific matter expeditiously. The clearness and transparency of the glass, and the being devoid of any colour but that intended to be given, are likewise necessary in both the hard glass and pastes which are to be coloured; and therefore to have them in perfection, a glass of each kind should be purposely prepared, in which more exact methods may be used for producing these qualities, than are expediently compatible with the despatch and profit of grosser manufactures. The best compositions for the hard glass are as follow; but as the extreme purity of the fixt alkaline salts is of very great consequence in this case, it may not be improper to give previously the method of producing it.

Method of bringing Pearl-Ashes, or any other fixt Alkaline Salt of Vegetables, to the highest degree of purity, proper for the most transparent Glass.

" Take of the best pearl-ashes three pounds, and of
 " salt-petre six ounces. Pound them together in a glass
 " or marble mortar till they are thoroughly well mixt,
 " and then put part of them into a large crucible, and
 " set it in a furnace, where it may undergo a strong
 " heat. When part of the matter that was first put into
 " the crucible is heated red hot, throw in the rest gradually,
 " and if the crucible will not contain the whole,
 " pour part of the melted matter out on a moistened

“ stone, or marble; and, having made room in the crucible, put in the rest, and let it continue there likewise till it be red hot. Pour it out then as the other, and afterwards put the whole into an earthen, or very clean iron pot, with ten pints of water, and heat it over the fire, till the salts be entirely melted. Let it then, being taken off the fire, stand till it be cold, and afterwards filter it through paper in one of the pewter cullenders described, p. 43, in the first volume of this work. when it is filtered, return the fluid again into the pot, and evaporate the salt to dryness, which will then be as white as snow, the nitre having burnt all the phlogistic matter that remained in the pearl-ashes after their former calcination.”

No. 1. Composition of the best and hardest Glass for receiving Colours.

“ Take of the best sand, cleansed by washing, as directed in p. 165, twelve pounds, of pearl-ashes, or fixt alkaline salt purified with nitre as above, seven pounds, of salt-petre one pound, and of borax half a pound.”

The sand being first reduced to powder in a glass or flint mortar, the other ingredients should be put to it, and the whole well mixt by pounding them together.

No. 2. Composition of the best Glass for receiving Colours, but somewhat less hard than the above.

“ Take of the white sand cleansed twelve pounds, of pearl-ashes purified with salt-petre, seven pounds, of nitre one pound, of borax half a pound, and of arsenic four ounces.”

Proceed as in the last, but if the glass be desired to melt with yet less heat, a pound of borax may be used instead of the half pound, and a pound of common salt may be added; but this last is apt to make the glass more brittle, which is an injury done to such as is to be cut into very small pieces, and ground with so many angles in the figure, as in the imitation of jewels.

No. 3. *Composition of soft Glass, or Paste, proper for receiving colours.*

"Take of white sand cleansed six pounds, of red lead three pounds, of purified pearl-ashes two pounds, and of nitre one pound."

Proceed in the mixture as with the foregoing.

No. 4. *Composition of Glass, or Paste, much softer than the above.*

"Take of white sand cleansed six pounds, of red lead and purified pearl ashes, each three pounds, of nitre one pound, of borax half a pound, and of arsenic three ounces."

To be mixt as all the preceding.

This is very soft, and will fuse with a very gentle heat, but requires some time to become clear, on account of the arsenic. It may even be prepared and tinged in a common fire without a furnace, if the pots containing it can be surrounded by burning coals, without danger of their falling into it. The borax, being a more expensive ingredient than the others, may be omitted where a somewhat greater heat can be applied, and the glass is not intended for very nice purposes, or a pound of common salt may be substituted in its place; but the glass will be more clear and perfect, and free itself much sooner from bubbles where the borax is used.

This glass will be very soft, and will not bear much water if employed for rings, buckles, or such imitations of stones as are exposed to much rubbing. But for ear-rings, ornaments worn on the breast, or such others as are but seldom put on, it may last a considerable time.

In all these soft compositions care should be taken that part of the sand be not left unvitified in the bottom of the pot, as will sometimes happen; for, in that case, the glass, abounding too much with salts and lead, will not bear the air, but being corroded by it, will soon contract a mistiness and specks on the surface,

which will entirely efface all the lustre of the paste. An unlucky instance of this particular happened a few years ago, to the great loss, and almost ruin of many of the poorer lapidaries; for there being at that time a great demand for all kinds of ornaments decorated with false stones for the Spanish West-India trade, a person undertook to make them and furnish the lapidaries, who, glad of an opportunity of obtaining, on moderate terms, what they had found it difficult to procure before, (as the coloured glass had for the most part been imported from Venice) purchased as large quantities as they possibly could find money to pay for; but in a short time, both the unwrought paste, and that which they had been at the labour and expence of cutting, all turned foul, with a dull scum on the surface, and little specks, which eat down into the substance, and took away the smoothness, as well as the lustre. It is proper, therefore, for those who prepare such compositions, to be careful of adding no more salts and lead than the proportions here given, and to watch that the sand, or other matter employed for the body of the composition, be really fluxed. And it is equally proper, that they who purchase such paste, should have some good ground of assurance of its being duly prepared, otherwise they may throw away their money in the purchase, their time in cutting, and their credit in disposing of such a faulty commodity.

There is a very certain and good method of preventing the inconvenience arising from the separation of the salts in the preparation, as well of the hard kind of coloured glass as the pastes, which is, by previously calcining the sand, and fixt alkaline salts, as in the manner of making the frit. This may be done by putting the sand and salt, reduced to powder, and mixed together, on a tile placed in a furnace of moderate heat, and turning over and stirring the matter with a tobacco-pipe, or small iron rod; for which purpose, the tile should be either placed near some proper opening into the furnace, or drawn to the door at due intervals. When the matter appears to coalesce strongly, and form a hard body on cooling, it may be taken out, and being kept entirely free from moisture, should be powdered. It should be then added to the other mate-

rials, according to the proportion that would have been observed with regard to the ingredients of the frit, if they had been used without being combined previously by means of this operation.

S E C T. IV.

*Composition of Glass, or Paste, of a Red Colour.*No. 1. *Composition of fine Red Glass resembling the Ruby.*

"TAKE of the hard glass, No. 1 or 2, one pound, of the *calx cassii*, or gold prepared by precipitation with tin, in the manner directed p. 203. of the first volume of this work, three drachms. Powder the glass, and grind the calx of gold afterwards with it in a glass, flint, or agate mortar, and then fuse them together."

This may be made of a stronger or more diluted colour, by varying the proportion of the gold, in adjusting which properly, regard should be had to the application of the glass when made; for where this glass is set in rings, bracelets, or other close work where foils can be used, a great saving may be made with regard to the colour of it; without much injury to the effect; but for ear-rings, or other purposes where the work is set transparent, a full strong colour should be given, which may be effected by the proportions directed in this composition.

No. 2. *Composition of Paste resembling the Ruby.*

"Take of the paste, No. 3 or No. 4, one pound, of *calx cassii*, or precipitation of gold by tin, two drachms. Proceed in the mixture as with the above."

This will be equally beautiful with the above, and defective only in softness; but as that greatly takes away the value for some purposes, such as is appropriated to them may be tinged in a cheaper manner by the following means.

No. 3. *Composition of a cheaper Paste resembling the Ruby.*

“ Take of the composition for paste, No. 3 or No. 4.
 “ half a pound, of glass of antimony half a pound, and
 “ of the precipitation of gold by tin, one drachm and a
 “ half. Proceed as with the others.”

This will be considerably cheaper, and will have much the same effect, except that it recedes more from the crimson to the orange.

No. 4. *Composition for hard Glass resembling the Garnet.*

“ Take of the composition for hard glass, No. 1 or
 “ No. 2, two pounds, of glass of antimony one pound,
 “ of magnesia, and of the precipitate of gold by tin,
 “ each one drachm.”

This composition is very beautiful, but too expensive, on account of the gold, for the imitation of garnets for common purposes, on which account the following may be substituted.

No. 5. *Cheaper Composition of hard Glass resembling the Garnet.*

“ Take of the compositions, No. 1 or No. 2, two
 “ pounds, of the glass of antimony two pounds, and of
 “ magnesia two drachms.”

If the colour be found too dark and purple in either this or the preceding composition, the proportion of magnesia must be diminished.

No. 6. *Composition of Paste of the Colour of Garnet.*

“ Take of the compositions for pastes, No. 1 or No. 2,
 “ and proceed as with the above.”

No. 7. *Composition of hard Glass resembling the Vinegar Garnet.*

“ Take of the compositions, No. 1 or No. 2, two
 “ pounds, of glass of antimony one pound, of iron,

"highly calcined, half an ounce. Mix the iron with
 "the uncoloured glass, and fuse them together till the
 "mass be perfectly transparent, then add the glass of
 "antimony powdered, stirring the mixture with the
 "end of a tobacco-pipe, and continue them in the heat
 "till the whole be perfectly incorporated."

No. 8. *Composition of Paste resembling the Vinegar Garnet.*

"Take of the composition for paste, No. 3 or 4,
 "and proceed as with the foregoing."

In all the compositions given in this, and the succeeding sections, it should be observed, that some allowance may be made in the proportion of the colorific, or tinging matter, for the greater gravity of the pastes than the hard glass, on the scoria of the lead which enters into the composition; for, as the volume in a pound weight of paste is consequently less, a less quantity of tinging matter is proportionably necessary to give the same force of colour to it.

S E C T. V.

Composition of Glass and paste of a Blue Colour.

No. 1. *Composition of hard Glass of a very full Blue Colour.*

"TAKE of the composition for hard glass, No. 1 or
 "No. 2, ten pounds, of zaffer six drachms, and
 "of magnesia two drachms. Proceed as with the
 "above."

If this glass be of too deep a colour, the proportions of the zaffer and magnesia to the glass may be diminished; and if it verge too much on the purple, to which cast it will incline, the magnesia should be omitted. If a very cool or pure blue be wanted, instead of the magnesia half an ounce of calcined copper may be used, and the proportion of zaffer diminished by one half.

No. 2. *Composition of Paste of a full Blue Colour.*

“ Take of the composition for paste, No. 1 or No. 2,
“ ten pounds, and proceed as with the foregoing.”

No. 3. *Composition of hard Glass resembling the Sapphire.*

“ Take of the compositions for hard glass, No. 1 or
“ No. 2, ten pounds, of zaffer three drachms and one
“ scruple, of *calx cassii*, or precipitation of gold by tin,
“ one drachm. Proceed as with the above.”

No. 4. *Cheaper Composition of hard Glass resembling the Sapphire.*

“ As the foregoing, only, instead of the precipitate
“ of gold, use two drachms and two scruples of mag-
“ nesia.”

If this be well managed, the colour will be very good, and the glass, when set and cut, will not be easily distinguishable from the true sapphire; but the preceding will be a finer colour, as there is a foulness in the tinge of the magnesia, which will always diminish, in some degree, the effect of brighter colours when mixed with them.

No. 5. *Composition of Paste resembling the Sapphire.*

“ Take of the composition for paste, No. 3 or No. 4,
“ and proceed as with the foregoing.”

It is not worth while to bestow the expence of colouring pastes with the gold, and it is therefore more expedient, in the case of such, to use the other method.

No. 6. *Composition of hard Glass and Pastes, resembling Sapphires, by means of Smalt.*

“ Take of the compositions for hard glass and pastes,
“ any quantity, and mix with them one-eighth of their
“ weight of smalt, the brightest and most inclining to
“ purple that can be procured.”

If it be desired to give a more purple tinge, magnesia may be added in the proportion required.

No. 7. *Compositions of hard Glass resembling the Eagle-marine, vulgarly called Egg-marine.*

"Take of the composition for hard glass, No. 1 or No. 2, ten pounds, of copper, highly calcined with sulphur, in the manner directed in the first volume of this work, p. 206, three ounces, and of zaffer one scruple. Proceed as with the foregoing."

No. 8. *Composition of Paste resembling the Eagle-marine.*

"Take of the composition for paste, No. 1 or No. 2, ten pounds, and proceed as with the above."

S E C T. VI.

Compositions of hard Glass and Pastes of a Yellow Colour.

No. 1. *Composition of hard Glass of Gold or full Yellow Colour.*

"TAKE of the compositions for hard glass, No. 1 or No. 2, ten pounds, but omit the salt-petre, and for every pound add an ounce of calcined borax, or, if that do not render the glass sufficiently fusible, two ounces, of red tartar, the deepest coloured that can be procured, ten ounces, of magnesia two ounces, of charcoal of fallow, or any other soft kind, two drachms. Proceed as with the rest."

This colour may be prepared with silver, but as there is no advantage in that to counterbalance the expence; I wave giving the process.

No. 2. *Composition of Paste of Gold or full Yellow Colour.*

"Take of the composition for paste, No. 3 or No. 4, prepared with salt-petre, ten pounds, of iron, strongly calcined, as directed in the first volume of this work, page 209, one ounce and a half. Proceed as with the others."

The crude tartar and the charcoal must not be used where lead enters into the composition of the glass, and

the nitre may be spared, because the yellow tinge given to the glass by the lead, on account of which the nitre is used, is no detriment in this case, but only adds to the proper colour. This colour may also be prepared by crude antimony, as well as the calcined iron, but it is more difficult to be managed, and not superior in its effect.

No. 3. *Composition of hard Glass resembling the Topaz.*

“ Take of the composition for hard glass, No. 1 or
“ No. 2, ten pounds, an equal quantity of the gold-
“ coloured hard glass. Powder and fuse them toge-
“ ther.”

As there is a great variety in the colour of the topaz, some being a deeper yellow, and others slightly tinged, the proportions of the yellow glass to the white may be accordingly varied at pleasure, that here given being for the deepest.

No. 4. *Composition of Paste resembling the Topaz.*

“ This may be done in the same manner as the pre-
“ ceding, but the salt-petre may be omitted in the ori-
“ ginal composition of the glass; and for the resem-
“ blance of the very slightly coloured topazes, neither
“ the gold-coloured paste, nor any other tinging mat-
“ ter need be added, that of the lead being sufficient,
“ when not destroyed by the nitre.”

No. 5. *Composition of hard Glass resembling the Chrysolite.*

“ Take of the composition for hard glass. No. 1 or
“ No. 2, ten pounds, of calcined iron six drachms.
“ Proceed as with the above.”

No. 6. *Composition of Paste resembling the Chrysolite.*

“ Take of the composition for paste, No. 3 or No. 4,
“ prepared without salt-petre, ten pounds, and of cal-
“ cined iron five drachms. Proceed as with the rest.”

S E C T. VII.

Composition of hard Glass and Paste of a Green Colour.

No. 1. *Composition of hard Glass resembling the Emerald.*

"TAKE of the composition for hard glass, No. 1
"or No. 2, nine pounds, of copper, precipitated
"from *aqua fortis*, according to the directions given in
"the first volume of this work, p. 207, three ounces,
"and of precipitated iron two drachms."

No. 2. *Composition of Paste resembling the Emerald.*

"Take of the composition for paste, No. 1 or No. 2.
"and proceed as with the above; but if the salt-petre
"be omitted in the preparation of the paste, a less pro-
"portion of the iron will serve."

S E C T. VIII.

Composition of Glazs and Pastes of a Purple Colour.

No. 1. *Composition of hard Glazs of a deep and bright Purple Colour.*

"TAKE of the composition for hard glass, No. 1
"or No. 2, ten pounds, of zaffer six drachms,
"of gold, precipitated by tin, one drachm. Proceed
"as with the rest."

No. 2. *Cheaper Composition of hard Glazs of a deep Purple Colour.*

"Take of the compositions for hard glass, No. 1 or
"No. 2, ten pounds, of magnesia one ounce, and of
"zaffer half an ounce."

No. 3. *Composition of Paste of a deep Purple Colour.*

“ Take of the composition for pastes, No. 3 or No. 4,
“ ten pounds, and treat them as the foregoing.”

No. 4. *Composition of hard Glass of the Colour of the Amethyst.*

“ Take of the composition for hard glass, No. 1 or
“ No. 2, ten pounds, of magnesia one ounce and half,
“ and of zaffer one drachm. Proceed as with the
“ rest.”

No. 5. *Composition of Paste of the Colour of the Amethyst.*

“ Take of the composition for paste, No. 1 or No. 2,
“ ten pounds, and treat it as the preceding.”

S E C T. IX.

Of Paste resembling the Diamond.

“ TAKE of the white sand six pounds, of red lead
“ four pounds, of pearl-ashes, purified as above
“ directed, three pounds, of nitre two pounds, of
“ arsenic five ounces, and of magnesia one scruple.
“ Proceed as with the others, but continue the fusion
“ for a considerable time on account of the large pro-
“ portion of arsenic.”

If this composition be thoroughly vitrified, and kept free from bubbles, it will be very white, and have a very great lustre; but, if on examination it yet appear to incline to yellow, another scruple or more of the magnesia may be added. It may be rendered harder by diminishing the proportion of lead, and increasing that of the salts, or fusing it with a very strong fire; but the diminution of the proportion of lead will make it have less of the lustre of the diamonds.

S E C T. X.

Composition of hard Glass and Paste perfectly Black.

Composition of hard Glass perfectly Black.

"TAKE of the composition for hard glass, No. 1. or No. 2, ten pounds, of zaffer one ounce, of magnesia, and of iron strongly calcined, each six drachms. Proceed as with the rest."

Composition of Pastes perfectly Black.

"Take of the composition for paste, No. 1. or No. 2, prepared with the salt-petre, ten pounds, of zaffer, one ounce, of magnesia six drachms. Proceed as with the others."

S E C T. XI.

Of the white opaque and semi-transparent Glass and Pastes.

No. 1. *Composition of white opaque Glass.*

"TAKE of the composition for hard glass, No. 1. or No. 2, ten pounds, of horn, ivory, or bone, calcined perfectly white, one pound. Proceed as with the others."

No. 2. *Composition of Paste of an opaque Whiteness.*

"Take of the composition, No. 3. or No. 4, ten pounds, and make the same addition as to the above."

No. 3. *Composition of Glass of an opaque Whiteness formed by Arsenic.*

"Take of flint-glass ten pounds, and of very white arsenic one pound. Powder and mix them tho-

“roughly, by grinding them together, and then fuse
 “them with a moderate heat till they be well incor-
 “porated, but avoid liquefying them more than to
 “make a perfect union.”

This glass has been made at a considerable work near London in great quantities, and has not only been manufactured into a variety of different kinds of vessels; but, being very white and fusible with a moderate heat has been much used as a white ground for enamel in dial-plates, snuff-boxes, and other pieces which have not occasion to go several times into the fire to be finished. It will not, however, bear repeated burnings, nor a strong heat continued for any length of time, when applied to this purpose, without becoming transparent, to which likewise the smoke of a coal-fire will also greatly contribute; but it answers the end very well in many cases, though even in those, enamel of the same degree of whiteness would be preferable, as this is always brittle, and of a less firm and tenacious texture.

No. 4. *Composition of hard Glass, or Paste, formed by Calx of Tin or Antimony.*

“Take of any of the compositions for hard glass, or
 “pastes, ten pounds, of calcined tin, (commonly called
 “putty) or of antimony, or tin calcined by means of
 “nitre, as directed in p. 199, of the first volume of
 “this work, one pound and a half; mix them well together,
 “ther, and fuse them with a moderate heat.”

The glass of this kind, made with the composition for pastes, differs in nothing from white enamel but in the proportion of the calx of tin and antimony; and those calxes be prepared with nitre, (without which they cannot be made to produce a pure whiteness in glass) this composition will be more expence and trouble than those above given, without any other advantage than that it will bear the action of a much stronger and longer continued fire, without losing its opacity in any degree than the others.

No. 5.

“T
 “paste
 “to a
 “with
 “This
 “German
 “cream-
 “which

Composition

Con

T
 horn,
 one o
 Fuse
 magn
 produ
 mix i
 toget
 heat
 then
 on a
 If it
 may b
 accordi
 his wor
 orax, a
 mixture,
 re desir
 ate heat
 firmly

No. 5. *Composition of semi transparent white Glass and Paste, resembling the Opal.*

"Take of any of the compositions for hard glass, or paste, ten pounds, of horn, bone, or ivory, calcined to a perfect whiteness, half a pound. Proceed as with the rest."

This white hard glass is much the same with the German glass formerly brought here in poringers, cream-pots, vinegar-cruets, and other such pieces, of which we frequently meet with the remains.

S E C T. XII.

Composition of coloured, opaque, and semi-transparent Glass.

Composition of fictitious or counterfeit Lapis Lazuli.

TAKE of any of the above compositions for hard glass, or paste, ten pounds, of calcined bones, horn, or ivory, three quarters of a pound, of zaffer one ounce and a half, and of magnesia half an ounce. Fuse the uncoloured composition with the zaffer and magnesia till a very deep transparent blue glass be produced. The mass being cold, powder it, and mix it with the calcined matter, by grinding them together. After which, fuse them with a moderate heat till they appear thoroughly incorporated, and then form the melted mass into cakes, by pouring it on a clean bright plate of copper or iron."

If it be desired to have it veined with gold, it may be done by mixing the gold powder prepared according to the directions given in the first volume of his work, p. 295, with an equal weight of calcined brax, and tempering them with oil of spike, by which mixture, the cakes, being painted with such veins as are desired, they must be put into a furnace of a moderate heat, and the gold will be cemented to the glass firmly as if the veins had been natural.

If the counterfeit *lapis lazuli* be desired of a lighter hue, the quantity of zaffer and magnesia must be diminished; or, if it be required to be more transparent, that of the calcined horn, bone, or ivory, should be lessened.

Instead of zaffer, where that cannot be obtained, a proper proportion of smalt may be substituted. And in all cases indeed, it may be a more certain way to form the zaffer and vitrifying ingredients into glass alone, and then having powdered them with the calcined bones or horns, infuse them a second time, and make them into cakes in the manner directed; for the fluxing power of the ingredients of the glass is so retarded by the calcined bone or horn, that it may, in some cases, fail to act sufficiently on the zaffer to vitrify it perfectly.

Composition of hard Glass resembling the red Cornelian.

“Take of the compositions for hard glass, No. 1 or No. 2, two pounds, of glass of antimony one pound, of the calcined vitriol, called *scarlet ochre*, prepared as directed, p. 57, of the first volume of this work, two ounces, and of magnesia one drachm.

“Fuse the glass of antimony and magnesia with the other glass first together, and then powder them well, and mix them with the scarlet ochre, by grinding them together, and afterwards fuse the mixture with a gentle heat, till they be incorporated; but the heat must not be continued longer than is absolutely required to form them into a vitreous mass.”

If it be desired to have the composition more transparent, a proportionable part of the red ochre must be omitted.

Composition of Paste resembling the red Cornelian.

“Take of the compositions for pastes, No. 1 or No. 2, two pounds, and proceed as with the above.”

Composition of hard Glass resembling the white Cornelian.

“Take of the compositions for hard glass, No. 1 or No. 2, two pounds, of yellow ochre, well washed,

two drachms, and of calcined bones, each one ounce. Mix them well by grinding them together, and fuse them with a gentle heat, till the several ingredients be well incorporated in a vitreous mass."

Composition of Paste resembling the white Cornelian.

"Take of the composition for pastes, No. 1 or No. 2, two pounds, and proceed as with the foregoing."

Composition of hard Glass, or Paste, resembling the Turquoise stone.

"Take of the compositions for blue glass, or paste, No. 7 or No. 8, (being those resembling the eagle marine) ten pounds, of calcined bone, horn, or ivory, half a pound. Powder and mix them well, and then fuse them in a moderate heat till they be thoroughly incorporated."

If the colour be not so deep as may be desired, a small proportion of smalt may be added.

Composition of the brown Venetian Glass with gold Spangles, commonly called the Philosopher's Stone.

"Take of the composition for hard glass, No. 2, and the composition for paste, No. 1, each five pounds, and of highly calcined iron one ounce. Mix them well, and fuse them till the iron be perfectly vitrified, and having tinged the glass of a deep transparent yellow brown colour. Powder this glass, and add to it two pounds of glass of antimony, being powdered, and mix them well, by grinding them together. Take part of this mixture, and rub into it fourscore or one hundred leaves of the counterfeit leaf-gold, commonly called *Dutch gold*; and, when the parts of the gold seem sufficiently divided, mix the powder containing it with the other part of the glass. Fuse the whole then with a moderate heat, till the powder run into a vitreous mass fit to be wrought into any of the figures, or vessels, into which it is usually formed; but avoid a perfect lique-

“faction, because that destroys in a short time, the
 “equal diffusion of the spangles, and vitrifies, at least
 “part, the matter of which they are composed, con-
 “verting the whole to a kind of transparent olive co-
 “loured glass.

This kind of glass is used for great variety of toys and ornaments with us, who, at present procure it from the Venetians; and a few years ago a very great demand arose for it to China, and raised the price very high, till such quantities had been brought from Venice and sent thither as glutted the market. But there is no reason why it should not be equally well prepared here and at a small expence, as will be found on a few trials by those who will carefully execute what is here directed.

CHAP. VIII.

Of the Fusion and Vitrification of the several Compositions of coloured Glass, with the particular Rules and Cautions to be observed in the management of each kind.

THE several compositions above-mentioned being prepared according to the directions respectively given, the matter should be put into proper pots, such as are described p. 179, of which it should not fill above two thirds; and then placed in the furnace, of which the construction is given p. 177, or in any other kind where they may receive a sufficient heat, and be secured from any coals, soot, or any other filth falling into them; in order to prevent which, it is expedient with regard to the pots in which this kind of glass is prepared, to have covers over the tops of them, with a little return over the side. And it is also proper to have a hole in the side a little below the return, through

which an iron may be passed to take out a small quantity of the melted matter, for the judging of the progress of the vitrification. These pots, when put into the furnace above-mentioned, should be placed on the flooring or stage intended to support them in the part betwixt the doors, opposite to that through which they are passed into the furnace, according to the manner before directed, which should be done by means of a strong iron peel, like those used by the bakers. It is necessary to observe, likewise, that however well the pots may have been before baked, it is always proper, in the case of glass of greater value, where the clearness and beauty is of consequence, to give them another burning before they be used, and, at the same time to encrust them over with any common colourless glass, which may be done in this manner. Having reduced the glass to powder, moisten all the inside of the pot with water; and, while it is yet moist, put some of the powdered glass, and shake it about till the whole inner surface of the pot be covered by that will adhere to it in consequence of the moisture. Throw out then the redundant part of the powdered glass, and the pot being dry, set it in a furnace sufficiently hot to vitrify the glass adhering to it, and let it continue there some time; after which, care must be taken to let it cool gradually.

The pots containing the composition being thus placed in the furnace, a gentle heat, such as will just keep the pots red-hot, should be given for the first hour or longer. There is, however an exception to this, which is where there is much arsenic in the composition, which requires that some degree of vitrification should be brought on as quickly as possible, in order to fix it, and prevent its subliming away from the other ingredients, which it will not cease to do, so long as continued in the state of a powder. But where a gentler heat is proper at first, after the expiration of an hour and a half, or two hours at furthest, the heat may be raised sufficiently to produce a vitrification, but not so as to render the melted matter very fluid at first, which in this part of the process would occasion a separation of the ingredi-

ents, and greatly retard, if not entirely prevent, the perfect vitrific incorporation of the whole.

The due degree or continuance of heat, for the perfecting these kinds of glass cannot be settled by any standard, as they are varied both by the nature of the composition and the quantity of the matter. But in the case of pots which hold ten or eleven pounds, twenty or twenty-four hours may be allowed for hard glass, and fourteen or sixteen for pastes. And where much arsenic enters into the composition, though it is necessary to bring on a quicker vitrification, yet more time must sometimes be given to the matter than in other cases, before all the cloudiness be dissipated.

In the fusion of the transparent coloured glass, it is above all things necessary to avoid stirring the matter, or even shaking the pots, as it would otherwise hazard the causing bubbles in the glass, to prevent which, is the greatest difficulty attending the preparation of counterfeit gems. But if the ingredients, by their action on each other, do yet, notwithstanding all exterior concussion be avoided, produced bubbles, the glass must be continued in fusion till they wholly vanish. And if, when bubbles do arise in the glass, and time be given for it, there appear no tendency to their going away, the heat must be gradually raised to a greater pitch, that the glass may be rendered more fluid, and that viscosity, which was the occasion of their detention, removed.

When a proper time has been given the glass to attain to a perfect state of vitrification, it should be examined, by putting the small end of a tobacco-pipe to the surface of the glass, through the hole in the side of the pot; which will bring away with it a little quantity of the glass, from whence the qualities may be judged of. And if there appear any defects that seem owing to the want of a due conversion of the ingredients to a vitreous state, more time and heat must be given to it; but if no such defects are found, and the glass appear perfect, the fire should be decreased, and, by degrees, suffered to go out; and the pots continued in the furnace till they become cold; after which, the pot should be torn off from the mass of glass contained in it. As

however, it is not always convenient to discontinue the heat of the furnace, when one or more pots of the glass may have attained to the due state of vitrification, they may, on such occasions, be taken out; and if the glass be not of great value, nor intended for very nice purposes, it may be formed into cakes, by pouring it on a clean plate of iron or copper, or into rolls. These cakes, or rolls, should be put into a moderate heat before they grow cold, and continued there for some time, that they may gain a good temper, so as to bear cutting or working in any way, according to the use they are intended for.

The transparent coloured glass is in most cases improved by continuing it in the heat, even for a considerable time after the vitrification seems perfected; as it is by that means rendered harder, and freer from specks and bubbles. But the semi-transparent kind, and opaque white formed of arsenic, must be taken just at the point when the ingredients are duly united; for a more mature vitrification converts to transparent glass the whole, or part of those substances which should not be brought to that state. But as I have before intimated in what particular cases this requires to be most attended to, it is needless to enlarge further on the matter here.

CHAP. VI.

Of colouring Rock Crystals for the Imitation of Gems.

THE far greater hardness of crystal than of any kind of glass, and the superior lustre of it to any but pailles, which are deplorably soft, have rendered the art of imparting to it the colours of gems an object of frequent and eager pursuit, as great advantages might probably have arisen from it to the first inventors.

There are two methods by which it has been conceived there was a possibility of doing it; the one by cementing, that is, impregnating the crystals by means of heat, with the proper tinging particles under the form of steam; the other by bringing the crystal to a state of fusion, through the means of heat aided by a strong flux, and combining it in that state with the proper colouring substances. Both of these have been pretended to be effected in a perfect manner, and very ostentatious accounts of them have been given to the public though it is much to be feared, that so far from having carried this art to any degree of perfection, there is not hitherto known one single fact, or principle, that in the least seems to lead to the attainment of it. As the world has been made to believe, however, as well more lately as formerly, by persons of some authority that both these methods have been practised with all the desired success, I will exhibit the particular manner in which each has been practised by those who have been believed to be most the masters of these arts.

“ Take of very yellow orpiment and white arsenic
 “ each two ounces, and of antimony and *sal ammoniacum*
 “ each one ounce; and having reduced them to powder, mix them well together, and put them into a
 “ large crucible. Over this mixture lay the pieces of
 “ rock crystal, first such as are of the least size, then
 “ larger, and at the top the biggest, taking care that
 “ those chosen for this purpose have no flaws nor faults.
 “ This crucible must then be covered by a lesser
 “ turned upside down upon it, in the bottom of which
 “ there should be previously made a little opening of
 “ the bigness of a pea, in order that this bottom, being
 “ coming now the top of the vessel, formed by joining
 “ the two together, the fumes of the matter contained
 “ may have vent through the hole, and, consequently
 “ being determined upwards, may pass through the
 “ crystals and act upon them. The joints produced
 “ by inverting the lesser crucible into the greater should
 “ be luted, and being dry, the vessel thus formed must
 “ be put in the midst of pieces of charcoal, in such
 “ manner that the undermost crucible may be buried in
 “ them entirely, and the uppermost half way. The

coals must then be kindled, and the fire suffered to burn very gradually without blowing, unless it should be necessary to keep it from extinguishing; to prevent which from happening too soon, the pieces of charcoal should be chosen large. As the fire rises, the mixture in the crucible will emit copious fumes, which being very noxious, must be carefully avoided; and to that end this operation should be always performed under a chimney, the front of which should be brought so low that all the smoke may be determined up it, and not spread itself in the laboratory, or other place. The fire must be kept up so long as any of these fumes appear to rise, and then permitted to go gradually out, and all access of cold air must be cautiously prevented. When the crucibles are grown entirely cold, but not before, the uppermost may be taken off, and the crystal will be found coloured, some pieces like topazes, and some like rubies, and a variety of other stones."

It has been said, that the crystals thus coloured have been cut, and produced fine imitations of the true stones; but the truth of the matter is, (notwithstanding all pretension to more) that they do appear, when taken out of the crucible, to be well coloured and beautiful, yet on further examination it is found that the whole effect is produced by a fallacious cause; for the crystals being cracked by the heat, as is almost universally the consequence of being exposed to this degree of it, the fumes have insinuated themselves into these cracks, and there producing the same effect as the paint used betwixt the two tables of doublets, the whole substance of the stone has the appearance of being tinged. But on due inspection, nevertheless, the crystals are found to be neither fit to be cut, on account of the flaws, nor to have acquired any colour, but what would instantly be destroyed on the separation of the several parts of the stones into which they are divided by the cracks, so that this method, together with many others of the same kind for giving colours to crystals by cementation, will be found to elude the hopes of those who try them with any confidence.

The other pretended method of colouring crystals,

by fusing them, and imparting the various tinges to them, while in a melted state, is thus performed.

“ Take of rock crystals any quantity, and put them
 “ in a covered crucible in a strong fire, where they
 “ must be continued for some time. Remove the crucible then out of the fire, and immediately throw the crystals into a vessel of clean cold water; from whence being again collected, they must be recalcined, and afterwards thrown into fresh water again in the same manner; and this operation must be repeated till the crystals be so changed in their texture, by the flaws and cracks produced by the sudden change from heat to cold, that they may be easily levigated. Powder the crystals thus calcined; and, to three pounds of them, add two pounds of purified pearl-ashes, or a pound and quarter of red lead, together with any of the tinging substances above-mentioned, in the proportion directed for colouring glass or pastes, and fuse them in the same manner also as has been before advised for other compositions. If the matter be found too difficult to be brought to a vitreous state by this proportion of pearl-ashes or lead, borax or arsenic may be added, as in other cases, in order to form a more powerful flux.”

The crystal, thus treated, produces however nothing more than a glass exactly of the same kind with that formed of the Lynn sand, which is in fact no other than a gross powder of crystal, and neither of them differs very essentially from such calcined flints as are wholly free from colour. The supposition therefore, that the crystal can be fused by this means, and, being tinged while in that state, reduced afterwards to its original hardness, is wholly groundless; for it cannot be fused by the heat of furnaces without the medium of some fluxing body added to it, and then its texture and properties are so changed, or rather the glass produced by the composition is so different from the crystal itself, that there does not appear to be the least advantage in employing rock crystal in forming such a composition, preferably to flints, even if they could be procured at the same expence, and required no greater trouble or labour in their use.

CHAP. X.

Of Doublets.

THE impracticability of imparting tinges to the body of crystals, while in their proper and natural state, and the softness of glass, which renders ornaments made of it greatly inferior in wear to crystal, gave inducements to the introduction of colouring the surface of crystal, wrought into a proper form in such manner, that the surfaces of two pieces so coloured being laid together, the effect might appear the same as if the whole substance of the crystal had been tinged. The crystals (and sometimes white transparent glass) so treated, were called *doublets*, and at one time prevailed greatly in use, on account of the advantages, with respect to wear, such doublets had when made of crystal, over glass, and the brightness of the colours which could with certainty be given to counterfeit stones this way, when coloured glass could not be procured, or at least not without a much greater expence. Doublets have not indeed the property which the others have of bearing to be set transparent, as is frequently required in drops of ear-rings and other ornaments. But when mounted in rings, or used in such manner that the sides of the pieces where the joint is made cannot be inspected, they have, when secured of crystal, the title to a preference to the coloured glass; and the art of managing them is therefore in some degree, of the same importance with that of preparing glass for the counterfeiting gems, and is therefore properly an appendix to it, as being entirely subservient to the same intention. The manner of managing doublets is as follows:

Let the crystal or glass be first cut by the lapidaries in the manner of a brilliant, except that, in this case, the figure must be composed from two separate stones, the parts of stones, formed in the manner of the upper

and under parts of a brilliant, if it was divided in an horizontal direction, a little lower than the middle. After the two plates of the intended stone are thus cut, and fitted so exactly that no division can appear when they are laid together, the upper part must be polished ready for setting, and then the colour must be put betwixt the two plates by this method.

“ Take of Venice or Cyprus turpentine two scruples, and add to it one scruple of the grains of mastic, chosen perfectly pure and free from foulness, and previously powdered : Melt them together in a small silver or brass spoon ladle, or other vessel, and put to them gradually any of the coloured substances below mentioned, being first well powdered, stirring them together as the colour is put in, that they may be thoroughly commixt. Warm then the doublets to the same degree of heat as the melted mixture, and paint the upper surface of the lower part, and put the upper one instantly upon it, pressing them to each other, but taking care that they may be conjoined in the most perfectly even manner. When the cement or paint is quite cold and set, the redundant part of it, which has been pressed out of the joint of the two pieces, should be gently scraped off the sides till there be no appearance of any colour on the outside of the doublets ; and they should then be skillfully set, observing to carry the mounting over the joint, that the upper piece may be well secured from separating from the under one.”

The colour of the ruby may be best imitated by mixing a fourth part of carmine with some of the finest crimson lake that can be procured ; which may be best made for this purposed of Brazil wood, by the process given in p. 65 of the first volume of this work.

The sapphire may be counterfeited by very bright Prussian blue, mixt with a little of the above mentioned crimson lake, to give it a cast of the purple. The Prussian blue should not be very deep coloured, or but a little of it should be used ; for otherwise, it will give a black shade that will be injurious to the lustre of the doublets.

The emerald may be well counterfeited by distilled verdigrise, with a little powdered aloes; but the mixture should not be strongly heated, nor kept long over the fire after the verdigrise is added, for the colour is not to be soon impaired by it.

The resemblance of the garnet may be made by dragon's blood, which, if it cannot be procured of sufficient brightness, may be helped by a very small quantity of carmine.

The vinegar garnet may be imitated with great success by the orange lake, for which the process is given in the first volume of this work, p. 99.

The amethyst may be counterfeited by the mixture of some Prussian blue with the crimson lake; but the proportions can only be regulated by discretion, as different parcels of the lake and Prussian blue vary extremely in the degree of strength of the colour.

The yellow topazes may be imitated by mixing the powdered aloes with a little dragon's blood, or by good Spanish anatto; but the colour must be very sparingly used, or the tinge will be too strong for the appearance of that stone.

The chrysolite, hyacinth, vinegar garnet, eagle marble, and other such weaker or more diluted colours, may be formed in the same manner, by lessening the proportions of the colours, or by compounding them together correspondently to the hue of the stone to be imitated; to which end it is proper to have an original stone, or an exact imitation of one at hand, when the mixture is made, in order to the more certain adapting the colours to the effect desired. When these precautions are taken, and the operation well conducted, it is possible to bring the doublets to so near a resemblance of the true stones that even the best judges cannot distinguish them, when well set, without a peculiar manner of inspection.

Where any kind of lake or Prussian blue is used for any purpose, it is best to grind or levigate it with spirit of turpentine instead of water, which will prevent its cracking again as it dries. The dragon's blood may be levigated with water, but the distilled verdigrise must be powdered dry. All the substances used as tinges for

doublets or foils must, however, be powdered as fine as possible, the brightness of the counterfeit stones for which they are used depending very greatly on that.

There is, however, an easy method of distinguishing doublets; which is only to hold them betwixt the eye and light in such position that the light may pass through the upper part and corners of the stone, which will then shew such parts to be white, and that there is no colour in the body of the stone.

CHAP. XI.

Of Foils.

SECT. I.

Of the general Nature and Preparation of Foils.

FOILS are thin plates or leaves of metal that are put under stones, or compositions in imitation of stones, when they are set.

The intention of foils is, either to increase the lustre or play of the stones, or more generally to improve colour, by giving an additional force to the tinge, whether it be natural or artificial, by that of a ground of the same hue, which the foil is in this case made to

There are consequently two kinds of foils; the one is colourless, where the effect of giving lustre or play to the stone is produced by the polish of the surface which makes it act as a mirror, and, by reflecting light, prevent that deadness which attends the having a duller ground under the stone, and brings it by double refraction of the light that is caused, near

the effect of the diamond. The other is coloured with some pigment or stain of the same hue as the stone, or of some other which is intended to modify and change the hue of the stone in some degree; as, where a yellow oil may be put under green, which is too much inclining to the blue, or under crimson, where it is desired to have the appearance more orange or scarlet.

Foils may be made of copper or tin; and silver has been sometimes used, with which it has been advised, for some purposes, to mix gold, but the expence of either is needless, as copper may be made to answer the same end.

Where coloured foils are wanted, copper may therefore be best used, and may be prepared for the purpose by the following means:

"Take copperplates beaten to a proper thickness, and pass them betwixt a pair of fine steel rollers, very close set, and draw them as thin as is possible to retain a proper tenacity. Polish them then with very fine whiting, or rotten stone, till they shine, and have as much brightness as can be given them, and they will then be fit to receive the colour."

But where the yellow or rather orange colour of the ground would be injurious to the effect, as in the case of purples, or crimson red, the foil should be whitened, which may be done by silvering it in the following manner:

"Take a small quantity of silver, and dissolve it in *aqua fortis*, and then put bits of copper into the solution, and precipitate the silver; which being thus precipitated, the fluid must be poured off, and fresh water added to it, to wash away all the remainder of the first fluid; after which the silver must be dried. An equal weight of cream of tartar and common salt must then be ground with it, till the whole be reduced to a very fine powder; and with this mixture, the foils, being first slightly moistened, must be rubbed by the finger, or a bit of linen rag, till they be of the degree of whiteness desired; after which, if it appear to be wanted, the polish must be refreshed."

Instead of rolling, the more general practice is to beat the copperplates, previously heated, betwixt two flat irons on an anvil, till they become of the thickness required, and then to give them an even surface by planishing hammer, before they are polished; but the use of the rollers is much more expeditious and effectual where the quantity demanded can defray the expense of purchasing them, with the other necessary work.

The tin foils are only used in the case of colourless stones, where quicksilver is employed; and they may be drawn out by the same rollers, but need not be further polished, as that effect is produced by other means in this case.

SECT. II.

Of the Colouring Foils.

THERE have been two methods invented for colouring foils, the one by tinging the surface of the copper of the colour required by means of smoke, the other by staining or painting it with some pigment or other colouring substance. The first is limited only to colours where blue is prevalent, and being troublesome and uncertain in the production, is not, on the whole, so eligible, in any case, as the latter; and shall therefore omit giving any directions for the practice of it, as all colours desired may be given to the foils by the other method; that is, by laying a pigment or other colouring substance on the surface, by means of some proper vehicle that may serve for spreading and fixing it to the copper as a cement.

The colours used for painting foils may be tempered with either oil, water rendered duly viscid by gum Arabic, or size, or varnish; and as there is no preference of one method to the other, but in particular cases, it is best to pursue all of them, according to the occasion that may be best served. Where deep colours are wanted, oil is most proper, because some pigments become wholly transparent in it, as lake or Prussian blue; but yellow and green may be better laid on in varnish,

the yellow may be had in perfection from a tinge wholly dissolved in spirit of wine, in the same manner as in the case of laquers; and the most beautiful green is to be produced by distilled verdigrise, which is apt to lose its colour, and turn black with oil. In common cases, however, any of the colours may be, with least trouble, laid on with isinglass size, in the same manner as the glazing colours used in miniature painting, for which ample directions may be found in the first volume of this work, from p. 135 to p. 140. The manner of using the colours in varnish will be likewise found in p. 142, and the following. The best method therefore of adapting foils to all the several purposes is as follows:

For red, where the ruby is to be imitated, carmine, with a little lake used in isinglass size, or shell-lac varnish, is to be employed, if the glass or paste be of a full crimson, verging towards the purple; but if the glass incline to the scarlet, or orange, very bright lake (that is purple) may be used alone in oil.—For the garnet red, dragon's blood, dissolved in seed-lac varnish, may be used; and for the vinegar-garnet, the orange-lake, (for the making which directions are given, p. 99 of the first volume of this work) tempered with shell-lac varnish, will be found excellent.

For the amethyst, lake, with a little Prussian blue, used with oil, and very thinly spread on the foil, will completely answer the end.

For blue, where a deep colour, or the effect of the sapphire is wanted, Prussian blue, that is not too deep, should be used in oil, and it should be spread more or less thinly on the foil, according to the lightness or deepness of which the colour is required to be.—For the eagle marine, common verdigrise, with a little Prussian blue, tempered in shell lac varnish, may be used.

For yellow, where a full colour is desired, the foil may be coloured with yellow laquer, laid on as for other purposes; for which full instructions are given in the first volume of this work, p. 336; and for the slighter colour of topazes, the burnish and foil itself will be sufficiently strong without any addition.

For green, where a deep hue is required, the crystals of verdigrise, tempered in shell-lac varnish should be

used; but where the emerald is to be imitated, a little yellow laquer should be added, to bring the colour to a truer green, and less verging to the blue.

The stones of more diluted colour, such as the amethyst, topaz, vinegar garnet, and eagle marine, may be very cheaply imitated by transparent white glass or paste, even without foils. This is to be done by tempering the colours above enumerated with turpentine and mastic, treated in the manner above directed, p. 230, for doublets, and painting the socket in which the counterfeit stone is to be set with the mixture, as well that as the socket and stone itself being previously heated. In this case, however, the stone should be immediately set, and the socket closed upon it before the mixture cool and grow hard.

The orange lake above mentioned was invented for this purpose, in which it has a beautiful effect, and was used with great success by a considerable manufacturer. The colour it produces is that of the vinegar-garnet, which it affords with great brightness.

The colours above directed to be used in oil should be extremely well ground in oil of turpentine, and tempered with old nut or poppy oil; or if time can be given for their drying, with strong fat oil, prepared as in p. 278 of the first volume of this work, diluted with spirit of turpentine, which will gain a fine polish of itself.

The colours used in varnish should be likewise thoroughly well ground and mixt; and, in the case of the dragon's blood in the seed-lac varnish and the laquer, the foils should be warmed before they are laid on.

All the mixtures should be laid on the foils with a broad soft brush, which must be passed from one end to the other, and no part should be crossed, or twice gone over, or, at least, not till the first coat be dry; when, if the colour do not lie strong enough, a second coat, or even a third may be given.

S E C T. III.

Of Foils for Crystals, Pebbles, or PASTE, to give the lustre and play of Diamonds.

THE manner of preparing foils, so as to give colourless stones the greatest degree of play and lustre, is by raising so high a polish or smoothness on the surface as to give them the effect of a mirror, which can only be done, in a perfect manner, by the use of quicksilver, applied in the same general way as in the case of looking-glasses. The method by which it may be best performed is as follows:

“Take leaves of tin, prepared in the same manner as for silvering looking-glasses, and cut them into small pieces of such size as to cover the surface of the socket of the stones that are to be set. Lay three of these then one upon another, and, having moistened the inside of the socket with thin gum water, and suffered it to become again so dry that only a slight stickiness remains, put the three pieces of leaves, lying on each other, into it, and adapt them to the surface in as even a manner as possible. When this is done, heat the socket, and fill it with warm quicksilver, which must be suffered to continue in it three or four minutes, and then gently poured out. The stone must then be thrust into the socket, and closed with it, care having been taken to give such room for it that it may enter without stripping off the tin and quicksilver from any part of the surface. The work should be well closed round the stone, to prevent the tin and quicksilver contained in the socket from being shaken out by any violence.”

The lustre of stones, set in this manner, will continue longer than when they are set in the common way, as the cavity round them being filled in this manner there will be no passage found for moisture, which is so injurious to the wear of stones treated in any other way.

This kind of foil gives some lustre to glass, or other transparent matter which has little of itself; but to

stones, or pastes, that have some share of play, it gives a most beautiful brilliance. It has been but little practised hitherto, I suppose from an ignorance of the manner of doing it; for, indeed, I never heard of more than one person, who is now gone from this country, who performed it to perfection; but he gave the stones a surprising lustre that made them not distinguishable from diamonds even by day-light. There is nevertheless at present one disadvantage attending the method as it is now practised, which is, that it can be only performed in the case of stones with a flat bottom. In consequence of which, the rose or table diamonds only can be imitated by it. But though the manner of doing it has not been hitherto discovered, yet it is certainly not impossible to contrive some way of setting stones of the cut of brilliants in this manner; in which case, if any of the crystal species, such as those called Bristol stones, Kerry stones, &c. were to be used, their far greater hardness, as well as much higher lustre, when treated in this way, would render them far superior to pastes.

Of

P

C

C

Of

P

ware

fest,

a sud

the f

cy, a

The

ed is

T

to a

acqu

on th

rema

gree

artifi

treffe

P A R T IV.

Of the Nature, Composition, Glazing, Painting, and Gilding of Porcelain, or China-Ware, and the conversion of Glass into Porcelain.

C H A P. I.

Of the general Nature and Management of Porcelain and China-Ware.

PORCELAIN, or China-ware, is formed of an artificial substance of a middle nature betwixt earthen ware and glass. It resists fusion in the fire, when perfect, equally with the first, and bears, in like manner, a sudden change with regard to heat and cold; but at the same time has, to a certain degree, the transparency, and entirely the close and even texture of the latter. The principle on which the substance of China is formed is as follows:

There are some kinds of earths, which being exposed to a strong heat, will, after some time, fuse or melt, and acquire the nature of glass, while there are others that on the contrary resist entirely the action of heat, and remain unaltered by it, at least with respect to that degree which can be applied by means of furnaces, or such artificial fires. The first of these kinds are called *vitreous* earths, the other *apryous*. Now, these two kinds

being mixt together in due proportion, they so operate on each other, that a matter, endued with the properties above enumerated, is consequently produced; for the vitrescent earth, though it is prevented by the other from liquefying so as to become fluid, yet melts to such a degree as to make the parts of the whole cohere and gain a semi-transparency; but the other affords a body, which, not having any propensity to melt, hinders a greater liquefaction of the whole by absorbing the fluid formed by the other, and gives consequently a proper rigidity or stiffness to the whole mass when hot, and at the same time prevents its gaining, when become cold, that vitreous grain or texture which would render it more transparent, as likewise brittle, and apt to crack or fly on any sudden change with regard to heat or cold.

The original kind of this ware, manufactured in China and Japan, was accordingly formed by a composition of two earths; the one vitrescible, which is called by the Chinese *Petunse*; the other apyrous, or resisting the action of heat, so as not to suffer itself to be fused or melted by the heat of a furnace, at least without the addition of some very powerful flux, and is called *Kaolin*.

The more perfect imitations of the China-ware in Europe have been, in like manner, made by the mixture of two kinds of earth. But others, where the true composition has not been understood, or the proper materials were not to be procured, have been formed of matter prepared by mixing with the earths some vitreous or fluxing substances. In consequence of this, the proportion of such fluxing substances, not being duly adapted to the resistance of the earth, the wares for the most part (though some of them have been very white, and of a good consistence while in the clayey state for working, and capable of sustaining the heat of the furnace) have yet not been able to bear hot water, when suddenly poured upon them, while they are cold, without cracking or suffering a separation of their parts.

The qualities of China-ware, when perfectly good, are to be very white and tenacious, so as not only to

bear
steel
water
witho
transp
grain
the ev
face,
compl
moist
or cas
ing th
slender
and to
any se
fusion,
these
any pi
which
absolu
The
much i
for ear
and th
pieces-
nace, w
nace w
The
tant pa
rally f
done b
fluxing
ter, of
withou
there,
the sm
compos
secret l
ferent
selves,
well an
any pie

bear violence without breaking, and strike fire with the steel as flint, but, as is said before, to suffer boiling water to be poured on it, while it is itself in a cold state, without being broken or cracked; to have a semi-transparent appearance; to break without shewing any grain in the divided parts, but seeming to have in them the even texture of glass; to shine on the exterior surface, as if a bright polish had been given to it; to be completely fit, while the composition is in the state of a moist paste, before it be dried or baked, to be modelled or cast with the greatest nicety and minuteness, retaining the figure, though wrought into the most thin and slender parts; to dry afterwards, without warping; and to undergo at last the baking or burning, without any separation of the parts, or flawing. If the composition, or the ware formed of it, be deficient in any of these points, they are so far faulty; and by examining any pieces of China with regard to those particulars which relate to the finished ware, the comparative or absolute goodness may be easily distinguished.

The baking or burning China ware is performed much in the same manner as is practised by the potters for earthen ware; except that it is done with more care, and that some expedients are used for defending the pieces from the injury of the smoke or dust of the furnace, which would deprave the colour, or infect the furnace with specks.

The glazing the ware of this kind is a very important part of the manufacture of it, and has been generally found the most difficult to be performed. It is done by spreading some soft glass powdered, or some fluxing composition, (either mixt with part of the matter, of which the ware itself is formed, or in some cases without) on the surface of the pieces, and melting it there, so as when cold to make an entire covering with the smoothness and shining appearance of glass. As the composition of the glazing has been generally kept a secret by those who have the direction, almost every different manufactory have employed one peculiar to themselves, and few have succeeded in forming such as will well answer the end. This may be seen by examining any piece of the ware, even by the naked eye; but more

distinctly with the assistance of a glass that magnifies largely; through which the surface will appear covered with, as it were, a net-work of an infinite number of cracks, (some of them frequently not small) that not only impair the polish, but give moreover a cast of grey-ness to the colour.

The painting and gilding China-ware is much the same as in the case of enamel, except in some particulars; as not only the same compositions for colours serve equally well for both, but in the manner of burning or fusing them is also alike, allowing for the difference of the figure of the pieces, and the number of them generally required to be burnt together. On this part of the manufacture, the value of the ware in general mostly depends, though it is indeed, properly considered, not a part of the art of making China-ware, but an auxiliary art employed only for the giving additional ornaments to it, being in fact only enamel painting applied to this purpose.

CHAP. II.

Of the Composition for China-Ware.

THE composition of the Eastern or proper China-ware, according to accounts that have great marks of authenticity, is from two earths; one of which is, as was before mentioned, vitrescent, and is called *Petunse*; and the other a refractory or apyrous earth, and called *Kaolin*.

Whether the earth called *Petunse* is formed of the spar lead, (as it is improperly called) used in the Dresden manufacture below spoken of, or whether of flints, or some species of sand, (for experience has shewn they will all answer the end, when they have no tinging matter in them, and will calcine to whiteness) is not

evid
part
that
clin
T
is a
flake
sum,
hand
colou
parce
black
were
not f
kind
where
know
moun
whit
agen
other
brou
woul
if th
inqui
some
TH
stone
wash
state,
dered
powd
being
be lac
partic
water
rest ti
laded
there
quant
again
repea

evident from any information hitherto brought to this part of the world. But the description given of it is, that it is a very hard whitish stone, or of a grey, inclining to the green.

The Kaolin is clearly what we call the Mica, which is a soft, laminated, shining earth, breaking into fine flakes with the least compression, like the *alumen pulmonum*, and glittering like spangles, when rubbed on the hand, or any other smooth surface. This is of different colours, some being of the purest whiteness, and other parcels of it yellowish and reddish, and very frequently black. It is found in large beds, which appear, as it were, artificially arched over with stone, and is either not so frequently to be found as many other of the like kinds of earths, or has been unobserved by the miners when they have met with it, perhaps from their not knowing it to be of any use. It was discovered in some mountains on the back of Carolina in great abundance, whither the proprietors of a work near London sent an agent to procure it for them; but he neglecting it for other pursuits, I believe no quantity has hitherto been brought from thence. I am, moreover, certain there would be no occasion to fetch it from so great a distance, if they who have occasion for it would make diligent inquiry after it in our own country, for I have seen some that has been found in the Derbyshire mines.

The preparation of the Petunse is by pounding the stone till it be reduced to a very fine powder, and then washing it over, to bring it to the most impalpable state, which is thus performed: After the stone is rendered as fine as it can by pounding or grinding, the powder must be put into a large tub full of water, and, being stirred about, the upper part of the water must be laded out into another tub, by which means the finest particles of the powder will be carried into it. The water in the second tub must be then suffered to stand at rest till the powder be subsided, and as much as can be laded off clear must be put back into the first tub, and there being again stirred about, and loaded with a fresh quantity of the subtile part of the powder, must be laded again into the second tub as before, and this must be repeated till none be left in the first tub but the grosser

part of the stone; which, not being of a due fineness, must be again pounded, and treated as at first. The fine powder, obtained in the second tub, must be then freed from the water, by lading off the clear part, and suffering what remains to exhale, till the matter become of the consistence of soft clay, when it will be fit to be commixt with the Kaolin for use.

The Kaolin is prepared in the same manner by washing over, but I have seen specimens of such as was so fine that there was no occasion for this, or any other purification.

From these two mixt together, the clay or paste is formed; but it is said, that the proportion of the respective quantities is made to vary accordingly to the intended goodness of the ware, the best being made from equal quantities, and the worst from two of the Kaolin to one of the Petunse. I do not see, nevertheless, any advantage arising from this, as at the same time the ware is rendered worse, no saving is made, but the contrary effect produced; but I take it for granted, that the Kaolin, or Mica, is every where more scarce than the Petunse, or vitrescent earth; and moreover much more fire, both with respect to degree and continuance, is necessary for the composition, where the proportion of vitrescent earth is so small, than where it is an equal quantity with the apyrus. I am apt therefore to believe there has been a mistake or omission in this part of the account, and that, though the proportion of one-third of the Kaolin to two-thirds of the Petunse may be right in forming the composition for the worse kind of China, yet the other two-thirds are supplied by calcined flints, or some other earth more vitrescent than the Petunse, which might be procured with much less labour and expence, and at the same time would require less force and duration of fire, than if the full proportion of Petunse were used.

The Saxon composition of the matter of which the China-ware is formed, is greatly similar to that of the Eastern. In the place of the Petunse, a stone is used, which is improperly called in the German language *bley spath*, or spar of lead. It is not a spar, but of a very contrary nature, as the spars are calcarious, that is, will

on ca
this i
will l
very
whiti
over,
and
The
other
and v
state
is on
rough
clay.
Th
the st
intim
by ro
the sa
with
the c
cakes
wood
and l
a kin
which
a sub
the ki
a feet
comes
like t
which
the ti
longe
prove
to av
may b
howe
it may
may b
unless

on calcining become lime, while, on the other hand, this is of a vitrescent nature, though it is said no fire will fuse it without some mixture. This spar is of a very hard texture, and of a light flesh colour, or pale whitish red. It is prepared by pounding and washing over, which may be done by the means above directed, and is then ready for compounding with the Mica. The Mica is employed in the Saxon composition for the other ingredient, and is likewise prepared by grinding and washing over, when it is not in a perfect and pure state; but when it is entirely free from all foulness, it is only tempered with water till the texture be thoroughly broken, and it be of the consistence of soft clay.

The two kinds of earth being thus prepared, and in the state of a soft paste, they are to be incorporated and intimately commixt together in one mass, which is done by rolling and stirring them well after they are put into the same vessel, and then kneading them, by treading with the feet, till a thorough union be procured. When the compound mass is thus formed, it is made up into cakes, or square pieces, and put by layers into cases of wood or stone, which must be placed in a moist situation, and left for two or three months; during which time a kind of putrid ferment happens in the mixture, by which the parts of a different matter combine and form a substance with new qualities, not found in either of the kinds while separate. This change shews itself by a foetid smell, and a greenish or bluish colour, which comes upon the whole mass, and a tenacity or cohesion like that of clay, or the argillaceous earths moistened, which was wanting in the matter at its first mixture. If the time of keeping the paste in this condition be prolonged for the space of a year or more, it will yet improve the qualities of it, but great care must be taken to avoid its becoming dry; to prevent which, if there may be occasion, it is very proper to water it. When, however, the above qualities are found in the matter, it may be deemed fit for use, and vessels or other pieces may be wrought of it, without any other preparation, unless in the case below excepted.

There are many other compositions which are, or may be used for imitation of the Eastern China-ware; but it does not appear practicable, from any other instance already known, to produce a matter endued with all the requisite qualities from the commixture of earths only without the addition of some fluxing or vitreous body, which may assist in giving them that tenacity and transparency which is necessary. The following composition however will produce wares which will have the properties of the true China, if they be rightly managed in the manufacture.

“ Take of the best white sand, or calcined flints, finely powdered, twenty pounds, add to it of very white pearl-ashes five pounds, of bones, calcined to perfect whiteness, two pounds. Temper the whole with gum water, formed by dissolving the gums Arabic or Senegal in water.”

This requires a considerable force and continuance of heat to bring it to perfection, but will be very white and good when it is properly treated. Where Mica can be obtained, it is preferable to the calcined bones, and as it will form a paste of kindly texture for working, a weaker gum water will serve, the necessity of using which at all in this kind of compositions is occasioned only by the want of proper cohesion and tenacity in the paste which such mixtures make.

“ Take of the best white sand, or calcined flints, finely powdered, twenty pounds, of very white tobacco-pipe-clay, or the Cornish soap rock clay washed over, five pounds, and of the whitest pearl-ashes four pounds. Temper them with a weak gum water.”

“ Take of the whitest sand, or calcined flints, finely powdered, twenty pounds, of flint, or any other colourless glass, powdered also, ten pounds, and of Mica, or calcined bones, two pounds. Temper them with gum water sufficiently strong to give them a due cohesion.”

There have been several similar compositions used for the imitation of China-ware in the works set on foot in different parts of Europe, and, amongst the rest, I have seen at one of those carried on near London, eleven mills at work, grinding pieces of the Eastern China, in

order, by the addition of some fluxing or vitreous substance which might restore the tenacity, to work it over again in the place of new matter. The ware commonly produced at this manufactory had the characters correspondent to such a mixture, for it was grey, full of flaws and bubbles, and, from want of due tenacity in the paste, wrought in a very heavy clumsy manner, especially with regard to those parts that are to support the pieces in drying. A very opposite kind is produced in another manufactory in the neighbourhood of London, for it has great whiteness and a texture that admits of its being modelled or cast in the most delicate manner; but it is formed of a composition so vitrescent as to have almost the texture of glass, and consequently to break or crack if boiling water be suddenly poured upon it, which quality renders it unfit for any uses but the making ornamental pieces. A later manufactory at Worcester has produced, even at very cheap prices, pieces that not only work very light, but which have great tenacity, and bear hot water without more hazard than the true China-ware. It may be hoped therefore that though the works at Dresden and St. Vincennes are esteemed the only manufactories in Europe, advanced hitherto to any degree of perfection, yet as there are no particular advantages in the situation of either of them that give them any claim to the monopolizing this art, we may see ourselves in time as much masters of this as of all the other manufactures duly cultivated and encouraged with us.

SECT. I.

Of the manner of formation of Vessels, Figures, Flowers, or other pieces of China-ware.

THE various kinds of pieces of China-ware are formed by three methods, turning, casting, and modelling; the particular manner of doing which, being the same in this case as in others; there will be little occasion to be explicit with regard to it.

Large vessels are generally turned in the same manner as is practised by the potters for stone or earthenware; but where they are intended to be of very nice and accurate figure, after they have the general form given to them, they are finished by putting them into proper moulds.

Figures, as also pieces, or ornaments of pieces, of the nature of bas-relief, are commonly cast in moulds, which is done in the same way as plaister of Paris is treated; for which directions will be found in the first volume of this work, p. 273; but some detached parts of ornaments, where no great precision of form is required, may be best modelled or worked by the hand.

Flowers, and other such loose designs, where latitude may be given to the fancy, are also most commodiously modelled or wrought with the hand, with the help of a small stick flattened at the point, a pair of pliers, and a wet sponge.

Where the parts of the pieces are very slender and thin, as particularly in the case of flowers, if the paste be not of itself of a very tenacious consistence, it should be always brought to a proper state of cohesion by tempering it with gum water; for the want of knowing which expedient, I have seen very coarse work done with great labour, and subject to frequent miscarriages, where the whole difficulty might have been easily surmounted by this means.

SECT. II.

Of the first baking or hardening the China-ware.

THE pieces being formed according to the manner above directed, must be gradually dried till they are capable of bearing heat without cracking; and they must be then baked for the first time, in order to give them a due hardness to bear the glazing. This baking is performed in the following manner; but before we proceed to the further particulars, it is proper to describe the apparatus necessary for it.

The furnace for baking the China-ware may be constructed in the same manner as the potters' kilns are usually built, and Windsor bricks, with mortar of Windsor loom, or Sturbridge clay, should be employed in its fabrication, or where they are not to be procured, such bricks and clay as most resemble them in their qualities, that is, in their resistance to vitrifying or calcining. The magnitude of this furnace must be according to the quantity of ware that is to be baked in it; but it should not be too small, because the body of fire may otherwise not be sufficient to produce the effect.

The cassettes or coffins in which the pieces are put, when placed in the furnace to be burnt, are the next material utensils. They should be of Sturbridge, or other good potter's clay, with a third of sand, and are generally made of a round form, with a flat bottom; the rim forming the sides being adapted to the height of the pieces they are intended to contain. They should be all of the same magnitude, as to diameter, that one may stand on the other when they are set into the furnace, in order to their being piled one above another as high as the furnace will admit, and a cover must be made for closing the uppermost. These cassettes may be best made by turning, or, on occasion, they may be formed in a mould.

The furnace and cassettes being prepared, the pieces of ware to be baked must be disposed in the cassettes according to the most advantage as to room, and then as many cassettes must be set one upon the other in the furnace as it will commodiously contain, leaving space for the fire to have a free passage betwixt the piles, and taking care to put the cover over the uppermost cassettes in each pile. The mouth of the furnace must then be closed, and the fire must be kindled, which should be of wood, and augmented at first by slow degrees; after which it should be raised so as to heat the cassettes red hot in every part of the furnace, and continued in this state for twelve or fourteen hours. It should then be suffered to extinguish, and the furnace left to cool gradually, and when little or no heat remains, the mouth may be opened, and the pieces taken out of the cassettes,

and they will be in a condition to receive the glazing, or to be painted with such of the colours as are used under the glazing.

SECT. III.

Of the Composition for, and manner of Glazing, China-ware.

THE glazing of the China-ware, as was observed before, is one of the most important and most difficult operations in the whole art of the manufacture, and is indeed the most imperfectly practised of any, with respect to that of the original or Eastern China. The method used by the Chinese is however said, on very good authority, to be as follows:

They take the finest pieces of the Petunse, and treat them, as is above-mentioned, by pounding and washing over; but extract, by repeated washings over, the very finest part of the powder, which, keeping so moist with the water that the mixture forms a liquid mass, they call the oil of Petunse; with this oil they mix an equal weight of borax; they then quench a quantity of quick-lime, and form layers of that and dried furze, which they set on fire when they have raised a large heap. After the first heap is burnt to ashes, they collect them and the lime, and form layers of them again with a fresh quantity of the furze, which they burn as before, and they repeat this five or six times. They then put the ashes and lime into a vessel with water, adding some borax, in the proportion of one pound to a hundred weight of the ashes, and they wash over the finer part of this mixture, and pour off at last all the fluid from the dregs, which they keep together with the solid part washed over. They mix this composition of lime, ashes, and salts, with the mixture above-mentioned of an equal quantity of the oil of Petunse and borax, and this compound forms the matter for glazing the ware.

Instead of the Petunse, the spar of lead used in the Saxon manufacture may be employed for forming a similar glazing, being treated in the same manner; and it

is said the glazing of the Dresden China is actually made in the same way. I question, however, that fact, and believe the real composition is a secret, which has not hitherto transpired. But if I cannot impart the method used there with so much authenticity as I could wish, I will, however communicate one used in another considerable manufactory, which excels the Dresden in this particular.

“Take of the finest white sand, or calcined flints, twenty pounds, of red lead eighteen pounds, of pearl-ashes ten pounds, and of common salt decrepitated, four pounds. Having levigated the sand or calcined flints and red lead well together, and afterwards mixt them thoroughly with the pearl-ashes and common salt, fuse the compound in the manner above directed for the treatment of glass, till it be perfectly vitrified. Then, having separated the fragments of the pot carefully from it, reduce it in a flat, agate, or porphyry mortar to an impalpable powder, and then temper it with water to the proper consistence for painting.”

When this glazing is to be used for any embossed, or other fine work, it should be mixed with a third of its weight of the spar of lead, or other vitrescent earth, used in the place of the Petunse, in the composition of the paste of which the ware is made, taking care that such earth be formed of the best pieces of the spar, or other substance used, and that it be rendered of an extremely great fineness, by washing over. The design of this addition is to weaken the fluxing powder of the glazing; which, if used alone, would run the corners and edges of the smaller parts, and impair the sharpness and spirit of the work. It is necessary, likewise, to pursue the same method in the case of pieces that are to be painted with designs of a more delicate kind; for the glazing, melting otherwise again in the burning in the colours, would become too fluid, and spread them so as to take away the effect of the fine touches.

The composition for glazing, of which kind soever it be, thus prepared and tempered to a due consistence, must be laid on the pieces of the ware after the first baking, and after such of them as are to be coloured

under the glazing, have been painted. This must be done with a proper brush, or with pencils, if there be embossed work or hollows, the greatest care being taken to spread it evenly on every part of the surface, and not fill or load the hollow parts, which are very apt to collect more than their due proportion from the brush. The glazing composition should be laid on the ware of the thickness of two sheets of writing paper, which, in case of nicer kinds of embossed work, is best done in two or three different coats, giving time for the one to be nearly dry before the other be laid on. When the pieces are thus covered with the matter of the glazing, they are ready for the second baking or burning.

SECT. IV.

Of the second baking or burning of the China-ware.

THE pieces of ware being glazed, must undergo a second baking or burning, in order to their due vitrification and hardening; the first being only to give them a proper tenacity and firmness to bear the laying on the glazing. But this operation being performed in a furnace of a different structure from the other, and which it is therefore proper to describe in this place, I shall give directions for the construction of it, before I proceed to speak further of its use.

This furnace is composed of four separate cavities, one over the other; the first of which serves as an ash-hole, and for conveying the air to the fuel through the bars; the second for a repository for the fuel; the third is an oven or kiln for receiving the ware that is to be burnt; and the last as a vent for the smoke, in order to preserve a communication with the chimney, and at the same time spread the flame and heat equally on all the piles of cassettes placed in the cavity under it. In order to erect such a furnace, the following method must be pursued; but the dimensions of the whole furnace may be varied, where there is occasion, adhering nevertheless to the same proportion.

The ground plan must be first marked out, of such figure and extent that it may allow of an oval cavity, of which the larger diameter is six feet, and the lesser four feet and a half, surrounded with a proper wall of the thickness of one brick and a half. The area of this inclosed space being marked out, the ground must be dug away within the circumscribed space, till a hole of the same figure and dimensions, and with a level bottom, be made of the depth of nine or ten inches below the level of the place. In the front of this hole, a furrow or trench must be also dug, of about a foot wide, and sloping gradually from the level ground of the place to the bottom of the hole; and it should also be lined at the bottom and sides with bricks or tiles for keeping the earth from breaking into it. The foundation of the brick-work must then be laid, by raising, within the hole, a wall round the ground which circumscribes it, of the thickness of one brick and a half, discontinuing the round, nevertheless, in the part where the furrow or trench enters. This wall may be built of common bricks, pointed with mortar made of lime and sifted ashes, and may be carried up to the height of three or four inches above the common level of the ground of the place, and then a strong frame with iron bars, for supporting the fuel, must be fixt, bearing sufficiently on the brick-work. A door and frame must likewise be placed in a proper position in the front of the furnace, for putting the fuel upon the bars, after which the brick-work may be again proceeded with, in the same manner as before, till it be a foot or fourteen inches above the bars. A roofing should be then formed of, as it were, several arches, so as to give as much opening as possible into the cavity where the cassettes with the ware are to be placed, and at the same time to furnish a proper flooring for supporting them; to which end the inequality of the surface formed by these arches on their upper side must be taken away, by filling up the hollow part, till a level be obtained, and the flooring so formed be, as it were, a grate of brick-work. The wall of the furnace must then be carried up ten feet, in the same dimensions and figure as at first; but this part requires only to be of one brick

thickness, and must have an opening in front sufficiently large to suffer the cassettes to be put in and piled upon each other; as also another smaller opening for looking into the furnace, and taking out small pieces, placed within reach, to serve as proofs for examining the progress of the operation, in order to judge when it is perfected. This principal chamber, or cavity of the furnace, must be terminated by a dome of the brick-work perforated in ten or twelve places, to afford so many vents to the smoke, of which three must be placed in the middle, in a triangular situation. These vents or holes must have registers or stoppers of baked clay fitted to them, in order that any of them may be stopped when the draught of the fire seems unequal, and one side of the furnace has more heat than the other. Over this arched cavity must be raised another of about four or five feet in height, which may be formed by continuing the oval-shaped wall of the furnace, and ending it by another dome of brick-work. Into this cavity an opening must be made like the mouth of an oven, sufficiently large to admit of the stoppers or registers of the vents or openings into it from below being taken out and put in occasionally, by means of a proper pair of tongs. In the middle of the dome, the chimney must be formed by carrying up a tube or funnel of very slight brick-work, of the diameter of about six inches, and the height of about three feet; or, instead of brick-work, this tube or funnel may be made of the red earthen-ware, which is at present frequently applied to such purposes near London, and will be a much less load to the furnace than brick work, though ever so slight. A register, which may be made by a sliding plate of iron, should also be placed at the vent into the chimney, that it may be closed up, when necessary, and all draught or communication betwixt the external air and the furnace prevented. The whole of the furnace above the bars for bearing the fuel, except the uppermost dome and the chimney, should be built of Windsor for bricks, and mortar formed of Windsor loam or Stourbridge clay; or, where they are not to be had, of such other kinds as will best bear the force of the heat. And it would be a great advantage likewise to point the

chamber, where the fuel is contained, as likewise the
 arch work and flooring over it, with the fire-lute; for
 the composition and treatment of which, directions will
 be found in the first volume of this work, p. 34.

The manner of baking or burning the China-ware in
 this furnace, is by putting the pieces before mentioned
 in cassettes, and raising piles of cassettes in the kiln, or
 principal chamber of the furnace, one over another, till
 the furnace be as full as it can well bear to be, leaving
 room for the fire to pass betwixt the piles, and play
 round them, as also to vent itself properly through the
 openings of the dome at the top. Some small pieces
 must be likewise put in as proofs, which should be re-
 sisted in a cassette that has an opening in the side of
 it, which must be placed near and opposite to the open-
 ing in the chamber, before directed to be made for ex-
 amining these proofs. When the whole is thus properly
 adjusted within the furnace, the openings into the prin-
 cipal chamber, as likewise that into the upper one for
 venting the smoke, must be closed, by walling up the
 large one, and luting a fire stone adapted to the figure
 of them in the two smaller. The fire must then be
 kindled, and kept at first low, increasing it only a few
 degrees for twenty-four hours. After this it must be
 augmented, from hour to hour, till it be raised to the
 highest degree that the furnace will admit of, and in
 that state it must be continued for six hours; by which
 time, if the composition of the paste were good, the
 ware will be vitrified to the proper degree, and attain
 the qualities above-mentioned to be requisite. But
 to be certain of this, it is proper to examine the proofs;
 which, if found to be satisfactory, the fire should be
 suffered to decay; and, after some hours, all the open-
 ings into the furnace, and communications with the ex-
 ternal air, should be effectually closed and stopped up,
 to prevent the cracking, as well of the cassettes as the
 ware they contain, on their becoming cold. In this
 condition the furnace should remain till the whole be
 perfectly cool; for which two or three days may be al-
 lowed. The ware may be then taken out, and will be fit
 for painting, where it is intended to be so ornamented.
 That there may be a greater certainty of success, it

is necessary, in conducting the operation, to observe attentively whether the flame and heat above described spread themselves equally and duly in all the parts of the furnace; and, if one side appear hotter than the other, from an irregular distribution of the draught of the furnace, one or two of the vents, placed in the triangular manner in the dome of the chamber, must be closed, that the flame may be determined to pass in a greater proportion up the other side of the furnace; and, if this do not suffice, some of the other vents may be likewise closed. It should be also observed to keep the fire as much as possible of one regular pitch, allowing nevertheless for the gradual argumentation; as otherwise, if it be alternately sunk and raised, it will be impracticable to form any effectual conjecture with respect to the time required for completing the operation.

S E C T. V.

Of the Painting and Gilding the China Ware.

THERE are two methods of treatment of the China ware, with respect to the painting; the first is, to lay on the colour under the glazing; the other, over it. The first is the most expedite, because it prevents the trouble and expence of a third burning; the second fully answering the purpose of fluxing the colour. Before the painting before the glazing be laid on is only practicable with respect to blue, and the brownish or scarlet red, which is seen along with the blue so frequently in the Oriental China; the other colours being too tender to bear so long a duration of heat and the fluxing power of the glazing, without flying or spreading themselves out of their proper bounds.

The painting, therefore, thus made under the glazing, must be performed by laying on the colours after the first baking; and for blue may be either small finely levigated, or, for darker tints, zaffer vitrified with borax in the following manner: "Take of white sand
" or calcined flints, three parts, of calcined borax,

“pearl-ashes, and of zaffer, each one part. Grind them well together, and then fuse them till the mass be perfectly vitrified; then levigate them a second time, and they will be fit for use.” For the red, calcined iron, or *crocus martis*, may be used; for which the best preparation is given in the first volume of this work, p. 27, under the article SCARLET OCHRE, and the calcined iron may be mixt with an equal part of any transparent white glass reduced to an impalpable powder. These colours, as the painting in this case is seldom intended to be performed with great nicety, may be tempered with water, and laid on with a pencil, as in other cases, but as thinly as possible, because, otherwise, in putting on the glazing it will be liable to be spread, and stain the white near it.

The painting, where other colours are used, being laid over the glazing, must consequently be done after the second baking, but as there is not the least difference betwixt this and other enamel painting, either with respect to the choice or treatment of the colours, it is unnecessary to enlarge on any particulars here, as the whole art of such painting is amply explained in the first volume of this work, under that head; only instead of muffles made in the form of coffins, as there directed, which are most proper for flat pieces, the round muffles, or cassettes, used for baking the China ware, are the most expedient to be employed for this purpose also.

The gilding China ware is mostly performed by means of the precipitate of gold made with copper, which is tempered with oil of spike, and laid on with a pencil, either before the glazing be put on, or along with the colours over the glazing, if it be intended to be burnished. The more particular explanation of its preparation and use will be found in p. 255 of the first volume of this work, under the article of GILDING ENAMEL AND GLASS, as may likewise several other methods of gilding applicable to China ware, under the same head. When the gilding on China ware is to be burnished, it must be done, after the last burning, by rubbing with a burnisher of jasper or agate, till a sufficient polish be obtained.

S E C T. VI.

Of the conversion of Glass into Porcelain, according to the method invented by Mr. Raumur.

THE principal on which the transformation of glass to porcelain depends, is this; that, as was observed before, porcelain being a glass imperfectly vitrified, it may be produced either by making such compositions as will endure heat, and vitrify only to a less degree, without a proportionable progression, beyond that point, to a more perfect state; or by reducing such glass as is perfectly vitrified back to that state.

On this principle, Mr. Raumur established his invention of making porcelain of glass; and on experiment he found it was practicable as well on the cheapest kinds, even that called the green glass, of which bottles are made, as of the finer. The manner of effecting this change is as follows:

The glass to be converted into porcelain should be first wrought into vessels, or other pieces, by the methods commonly used for glass; and when they are so wrought, they should be put into cassettes, such as were before described, p. 249, for the burning China. Along with the pieces of glass must be put a mixture of equal parts of plaister of Paris and fine sand, so as to fill the cassettes, not leaving even the least interstice or void betwixt any of the pieces of glass. The cassettes are then to have the covers put on them, and are to be placed one upon another, as was directed p. 246, for the China ware, if there be more than one, and the dimensions of the furnace admit it, and these cassettes put into a proper furnace, which may be either a common potter's kiln, or any other kind where a similar heat may be given, and there they must be continued for the usual time given for baking pots. After thus burning a due time, and that the cassettes are become cold, the pieces may be taken out, but will no longer appear to be glass, but a very beautiful kind of China, which may be afterwards painted, or otherwise ornamented in the same manner as the real.

PART V.

Of the preparation of transparent and coloured Glazings for Stone or Earthen Ware.

N. B. *The recipes in Italic are taken from Kunckel, being, as he affirms, the true Glazings used at Delft, and other Dutch manufactories.*

Common Glazing for any kind of Earthen Ware.

“TAKE of white sand forty pounds, of red lead twenty pounds, of pearl-ashes twenty pounds, and of common salt twelve pounds: Powder the sand by grinding before it be mixt with the other ingredients, and then grind them together; after which calcine them for some time, with a moderate heat, which must be less than will make them melt and run to glass; and when the mixture is cold, grind it to powder again, and, when wanted, temper it with water, and it will then be fit for use.”

The proportions of these ingredients may be varied occasionally; for where the glazing can be fluxed conveniently with a very strong fire, the quantity of sand may be increased to sixty or seventy pounds, which not only renders the glazing stronger, but makes a saving in the expence. The proportion of pearl-ashes, which is the dearest ingredient, may likewise be diminished; or they may be wholly omitted where the ware is designed for very coarse purposes, and not for domestic uses, where the lead is very improper, being extremely apt to be corroded by acids, and to produce a very un-

S E C T. VI.

Of the conversion of Glass into Porcelain, according to the method invented by Mr. Raumur.

THE principal on which the transformation of glass to porcelain depends, is this; that, as was observed before, porcelain being a glass imperfectly vitrified, it may be produced either by making such compositions as will endure heat, and vitrify only to a less degree, without a proportionable progression, beyond that point, to a more perfect state; or by reducing such glass as is perfectly vitrified back to that state.

On this principle, Mr. Raumur established his invention of making porcelain of glass; and on experiment he found it was practicable as well on the cheapest kinds, even that called the green glass, of which bottles are made, as of the finer. The manner of effecting this change is as follows:

The glass to be converted into porcelain should be first wrought into vessels, or other pieces, by the methods commonly used for glass; and when they are so wrought, they should be put into cassettes, such as were before described, p. 249, for the burning China. Along with the pieces of glass must be put a mixture of equal parts of plaister of Paris and fine sand, so as to fill the cassettes, not leaving even the least interstice or void betwixt any of the pieces of glass. The cassettes are then, to have the covers put on them, and are to be placed one upon another, as was directed p. 246, for the China ware, if there be more than one, and the dimensions of the furnace admit it, and these cassettes put into a proper furnace, which may be either a common potter's kiln, or any other kind where a similar heat may be given, and there they must be continued for the usual time given for baking pots. After thus burning a due time, and that the cassettes are become cold, the pieces may be taken out, but will no longer appear to be glass, but a very beautiful kind of China, which may be afterwards painted, or otherwise ornamented in the same manner as the real.

PART V.

Of the preparation of transparent and coloured Glazings for Stone or Earthen Ware.

N. B. *The recipes in Italic are taken from Kunckel, being, as he affirms, the true Glazings used at Delft, and other Dutch manufactories.*

Common Glazing for any kind of Earthen Ware.

“TAKE of white sand forty pounds, of red lead
“ twenty pounds, of pearl-ashes twenty pounds,
“ and of common salt twelve pounds: Powder the sand
“ by grinding before it be mixt with the other ingre-
“ dients, and then grind them together; after which
“ calcine them for some time, with a moderate heat,
“ which must be less than will make them melt and run
“ to glass; and when the mixture is cold, grind it to
“ powder again, and, when wanted, temper it with wa-
“ ter, and it will then be fit for use.”

The proportions of these ingredients may be varied occasionally; for where the glazing can be fluxed conveniently with a very strong fire, the quantity of sand may be increased to sixty or seventy pounds, which not only renders the glazing stronger, but makes a saving in the expence. The proportion of pearl-ashes, which is the dearest ingredient, may likewise be diminished; or they may be wholly omitted where the ware is designed for very coarse purposes, and not for domestic uses, where the lead is very improper, being extremely apt to be corroded by acids, and to produce a very un-

wholesome substance. On this account, where good manufactures are established, the lead ought to be excluded from the composition of the glazings, and other fluxes used in its stead, as in the following recipe :

Transparent Glazing for any kind of Earthen Ware prepared without Lead.

“ Take of white sand forty pounds, of pearl-ashes twenty-five pounds, and of common salt fifteen pounds; calcine them, and proceed as with the above.”

When the expence can be suffered, this glazing may be improved by adding one or two pounds of borax, and diminishing the pearl-ashes in the proportion of six pounds for one pound of the borax added, or ten pounds for two; in the latter case, two pounds of salt may be also kept out of the composition. The reason for this change is, that if the composition contain so large a proportion of salt, and the glazing be not fluxed for a long time after it has laid on the ware, it will be apt to be dissolved by boiling water, and peel off, if it be exposed to the action of it for any long time.

This glazing may likewise be rendered better by the use of wood-ashes, instead of part of the pearl-ashes; but it can only be well done where the ashes can be procured to be burnt till they be white and free from all coal, or imperfectly calcined parts of the wood or vegetable matter of which they are formed. The proportion may then be as follows :

More perfect transparent Glazing, prepared with Wood-ashes.

“ Take of sand forty pounds, of wood-ashes, perfectly burnt, fifty pounds, of pearl-ashes ten pounds, and of common salt twelve pounds.”

This will make an admirable glazing, where the ashes are pure, and a strong fire can be given to flux it when laid on the ware. It will be perfectly free from the imperfection of the above, and will be very hard and glossy; and where the expence can be allowed, it may

be made more yielding to the fire by the addition of borax, in which case no alteration need be made in the proportion of the other ingredients.

Preparation of the Masticot, which is used by the Dutch as the ground of their Glazings.

"Take of clean sand one hundred weight, of soda forty-four pounds, and of pearl-ashes thirty pounds; calcine the mixture."

The soda not being employed in this country, those who would use masticot must increase the quantity of pearl-ashes in an equivalent proportion, and therefore seventy pounds should be employed instead of the thirty. The calcination may be performed in the same manner as was before directed for preparing frit, p. 193.

Soda is, however, sold here under the name of Barilla, and may be therefore obtained easily at a low price.

Preparation of Masticot for a white Glazing.

"Take of masticot, prepared as in the preceding, one hundred pounds, of calx of tin eighty pounds, and of common salt ten pounds; calcine and powder this composition three several times."

The calx of tin is prepared, as has been before observed in the first volume, by those who make it their business, and is sold under the name of putty. Its goodness consists in its whiteness and its purity; the first of which is easily distinguished by comparing any parcel in question, with a specimen of any that is known to be good. The adulteration of it, which is almost constantly practised by those who prepare or sell it, may be discovered with certainty by the means taught in the first volume of this work, p. 198; but the sophistication is not, however, any other way injurious to the effect than by occasioning an error of proportion in the ingredients of the composition. At present it is a practice, where the most perfect works of this kind are carried on, to add a small proportion of zaffer, to break the yellow hue, and give a truer hue of white. The

proportion must depend on the degree of yellow tinge. As blue and yellow, however, form green, the use of equal parts of magnesia and zaffer would be a greater improvement, as appears from the use of magnesia in white transparent glass for the same purpose. The quantity of the calx of tin in this recipe, which Kunckel has given as one of the white glazings used at Delft, would be much too great for that of the other ingredients, if he had really meant what is properly so called, viz. the tin calcined alone to a white substance; but he does not mean the simple calx of tin, but a composition of calcined lead and tin, as the recipe for preparing what he calls the calx of tin, subjoined to that above given, evidently shews; which recipe is as follows:

Of the preparation of the calx of Tin according to Kunckel.

“ Take of lead one hundred pounds, and of tin thirty-three pounds; calcine them in the manner practised by the potters, and they produce what the Dutch call the fine matter for the white glazing.”

This is at present an unnecessary work for the potters, as the lead is calcined in large works under the name of red lead, and sold by those who, carrying on great concerns, can afford it on much better terms than potters, or others who use it, could make it for their own consumption only.

The tin being likewise, as was above observed, calcined by those who make it their particular business, and have a suitable apparatus, is much more profitably purchased than prepared in this state. The above recipe ought therefore, according to the modern practice, to stand as follows:

More explicit recipe for the preparation of Masticot for a white Glazing.

“ Take of masticot, prepared as above, one hundred pounds, of red lead sixty pounds, of calcined tin or putty twenty pounds, and of common salt ten pounds. Mix them, and calcine and powder the mixture several times.”

Another preparation of a white Glazing.

“ Take two pounds of lead, and somewhat more than a pound of tin ; calcine the two metals till they be reduced to a powder, by the means used by the potters ; take then two parts of these ashes, one part of white sand, calcined flints, or broken white glass, and half a pint of common salt & mix well together the several ingredients, and set the matter to bake in a proper furnace, and urge it at length to melt.”

The trouble of calcining the tin and lead may be saved here, as well as on the occasions above mentioned, by procuring them already reduced to a proper state.

Another preparation of a White Glazing.

“ Take one pound and a half of lead, and one pound of tin ; reduce them to the state of a calx, and then take of the calcined matter eight parts, and of calcined flints and common salt each four parts ; bring the mixture by heat to a state of fusion.”

Another preparation of a White Glazing.

“ Take of lead three parts, and of tin one part ; calcine them, and then take of this matter, and of calcined flints and common salt, each two parts ; fuse them by the above.”

Another preparation of White Glazing.

“ Take of lead four pounds, of tin one pound ; calcine them, and take of the matter eight parts, of calcined flints seven parts, and of common salt fourteen parts ; fuse them as the others.”

I suspect there is an error with respect to the fourteen parts of common salt, on account of the great excess of the proportion, and imagine it was intended to be only four.

Preparation of a White Glazing which may be put upon vessels of Copper.

“ Take of lead four pounds, of tin one pound, of flint four pounds, of common salt one pound, and Venetian glass one pound; melt the mixture, and it will be fit for use.”

This is according to the expression of Kunckel, but it must be understood that by the lead and tin is meant red lead and the calx of tin, and that the flints must be always calcined. This is called by Kunckel a glazing; but by the application of it to copper, it comes within the notion of enamel, and ought to be called white enamel.

Another preparation of a White Glazing.

“ Take of lead six pounds, and of tin one pound; calcine them, and take of the matter twelve parts, of flints fourteen parts, and of common salt eight parts; fuse them as the others.”

Preparation of a very fine White Glazing.

“ Take of lead two parts, and of tin one part; calcine them, and take of the matter one part, of flints and common salt each one part; fuse the mixture.”

Preparation of an Enamel for Earthen Ware for Painting White upon a White Ground.

“ Take of tin any quantity, and inclose it in clay or loam, and put it in a crucible; place the crucible in the fire, that the tin may calcine, and then break it; there will be found a calx very white, and when it is used to paint with on a white ground the colour will come forth, and be much more white than that of the ground.”

This recipe appears very extraordinary; for I can by no means believe that tin, thus treated, can be all calcined, as the action of the air, or the presence of nitre, are equally necessary with heat to that end; nor

does it seem probable, if the tin was calcined by this means, that it would be a calx of greater whiteness than when calcined by any other method. I have inserted it nevertheless as given by Kunckel, who says immediately below, that he has tried all these recipes himself, or seen them tried by others. If, however, (as I am certain it is not to be produced this way) a calx of tin of extraordinary whiteness be wanted for painting on a white glazed ground, the tin should be calcined by means of nitre, for which directions are given p. 198 of the first volume of this work; and the calx formed by that operation, if rightly managed, will be extremely white, and fit for the purpose.

Preparation of a Yellow Glazing.

“ Take of tin and antimony each two pounds, of lead three pounds; or, according to some, equal quantities of all the three ingredients; calcine all of them, and put them at last in fusion, that they may be vitrified. This glazing will run very soon, and be of a fine yellow colour.”

The calcining the tin, lead, and antimony together, as seems here directed, would be a very tedious operation. The calcined tin, as commonly to be procured, and red lead should therefore be used, and the antimony should be calcined alone. But it is not to be understood that the antimony is to be calcined for this purpose to whiteness, or the state of a perfect calx, which is not easily practicable without nitre, and, if effected, would render the antimony incapable of producing any other colour than whiteness. The operation must therefore be performed with a slow fire, by roasting, as it were, the antimony till it lose its metallic appearance, and become a greenish powder, as is practised in the making the glass of antimony.

Another preparation of Yellow Glazing.

“ Take five parts of red lead, two parts of powdered brick, one part of sand, one part of any of the preceding white glazings, and two parts of antimony. This mix-

"ture must be calcined, and then fused, and it will give a
"fine yellow glazing."

Preparation of a Lemon-coloured Glazing.

"Take of red lead three parts, of powdered bricks that
"are very red three parts and a half, and of antimony one
"part; calcine the mixture day and night, for the space of
"four days, in the ash-hole of the glass-house furnace; urge
"it at last to fusion, and it will produce a very fine lemon-
"coloured glazing."

But it is proper to observe, that the success of the operation depends greatly on the fineness of the colour of the bricks that are powdered. Those which are of a fine red, and very brittle, are the best; but such as are grey will not at all answer the end. The same attention should be had to this matter wherever bricks are used in these kind of preparations.

Another preparation of a Yellow Glazing.

"Take seven parts of the mixture of the calxes of tin and
"lead, mentioned before in the recipe for preparing the
"massicot for a white glazing; add one part of antimony,
"and fuse them together."

Another preparation of a Yellow Glazing.

"Take four parts of white glass, one part of antimony,
"three parts of red lead, and one part of iron scales; fuse
"the mixture."

Another preparation of a Yellow Glazing.

"Take sixteen parts of flints, one part of filings of iron,
"and twenty-four parts of litharge; fuse the mixture."

Preparation of a light Yellow Glazing.

"Take of red lead four parts, of antimony three parts, of
"the mixture of the calxes of lead and tin before mentioned,

"in the preparation of the masticot for a white glazing,
"eight parts, and of glass three parts."

When the red lead and calx of tin are used, instead of the mixture of them calcined together, as was before advised, the proportion of the ingredients will be, of red lead ten parts, of antimony and glass each three parts, and of calcined tin two parts.

Preparation of a gold-coloured Yellow Glazing.

"Take of red lead three parts, of antimony two parts,
"and of saffron of Mars one part; fuse the mixture, and,
"having powdered the mass, melt it again, and repeat this
"operation to the fourth time, and a fine gold-coloured yellow will be produced."

Any preparation of calcined iron may be used in the place of the saffron of Mars, and the repeated fusions and levigations seem not necessary.

Another preparation of a gold-coloured Yellow Glazing.

"Take of red lead and antimony, each one ounce, and of
"scales of iron half an ounce; fuse the composition four or
"five times."

Another preparation of a gold-coloured Yellow.

"Take eight parts of red lead, six parts of flints, one part
"of yellow ochre, one part of antimony, and one part of
"white glass; calcine and fuse them together, and they will
"form a fine gold-coloured yellow."

Another preparation of gold-coloured Yellow.

"Take of red lead and of white flints each twelve parts,
"of filings of iron one part; fuse them twice."

This glazing will be transparent, though Kunckel has omitted to imitate it. Care must therefore be taken what ground it be laid upon, or it will not answer the end of a yellow, but combine with that of the ground; and, indeed, the body of colour is too weak to produce

any other than a feint yellowish cast even on a pure white ground.

Preparation of a Green Glazing to be laid on a White Ground.

“ Take of calcined copper one part, and two parts of any
“ of the preceding yellow glazings; fuse them twice; but
“ when the composition is used it must not be laid on too
“ thick, for that would render the colour too deep.”

Another preparation of a fine Green Glazing.

“ Take of the Bohemian granate one part, of filings of
“ copper one part, of red lead one part, and of Venetian
“ glass one part; fuse the whole, and it will afford a very
“ fine green, but the mixture may be used without being
“ previously melted.”

Preparation of a Green Glazing.

“ Take two parts of red lead, two parts of Venetian glass,
“ one part of filings of copper; fuse the mixture, and it will
“ be fit for use.”

Another preparation of a fine Green Glazing.

“ Take of white glass one part, of red lead and filings of
“ copper, each one part; fuse the mixture, and afterwards
“ powder the mass. Take of this powder two parts, and
“ of Bohemian granate one part, and they will produce a
“ very fine green.”

Another preparation of a fine Green Glazing.

“ Take of any of the yellow glazings already given, and
“ add to it an equal quantity of any of the blue glazings
“ given below: Mix them thoroughly well together by
“ grinding, and they will produce a green that will be bright
“ and good, in proportion to the yellow and blue used for its
“ composition.”

This is the readiest way of forming greens for every purpose, as by the choice of the kind of yellow and blue, and the variation of the proportion of one to the other, all shades and tints of green may be with certainty produced.

Preparation of a fine Blue Glazing.

“ Take one pound of red lead, two pounds of powdered flints, two pounds of common salt, one pound of tartar, calcined till it be almost white, half a pound of white glass or Venetian glass, and half a pound of zaffer; fuse the whole mixture, and quench the melted mass in water; then melt and quench the matter over again, and repeat several times the same operation. The same proceeding must be adhered to in all the compositions where the tartar enters, otherwise they would be too much charged with salt, and the colour prove not fine.” It is proper, moreover, to calcine the mixture gently, day and night, for forty-eight hours in a glass-house furnace.”

Another preparation of a Blue Glazing.

“ Take one pound of tartar, a quarter of a pound of red lead, half an ounce of zaffer, and a quarter of a pound of powdered flints; fuse the whole, and proceed in the manner taught in the preceding recipe.”

Another preparation of a Blue Glazing.

“ Take two pounds of lead and tin; calcine them, and add five pounds of common salt, five pounds of powdered flints, and of zaffer, tartar, and Venetian glass, each one pound: Proceed as was before directed with regard to the calcination, and afterwards fuse the mixture.”

The red lead and calcined tin may be used as well as in the former instances, where they are directed to be purposely calcined.

Another preparation of Blue Glazing.

“ Take of tartar one part, of common salt two parts, of flints one part, and of red lead and zaffer each one part. Let the treatment be the same as with the preceding.”

Preparation of another Blue Glazing.

“ Take of red lead one part, of sand three parts, and of
 “ zaffer, or, in default of it, blue enamel, one part.”

Kunckel has directed the substitution of the blue enamel here for the zaffer, as if the effect would be the same, which is an egregious error; for the proportion of zaffer is sufficient, or indeed even too great to make the deepest blue that can be produced; whereas the same quantity of the blue enamel, so treated, can only afford a blue-glazing six times lighter than its own colour.

Another preparation of a Blue Glazing.

“ Take one part of red lead, three parts of sand, one part
 “ of zaffer, or, in its stead, blue enamel.”

Besides the errors mentioned in the observations on the preceding recipe, this contains another, which regards the proportion of sand to the red lead; for the quantity of the red lead is not a sufficient flux for half the quantity of sand; and unless some proportion of salts be added, the sand should never be used in a greater proportion than an equal weight in these compositions.

Another preparation of a Blue Glazing.

“ Take two pounds of red lead, and of flints and zaffer
 “ each a quarter of a pound; grind the ingredients, and fuse
 “ them in the common manner.”

Another preparation of a Blue Glazing.

“ Take four pounds of red lead, two pounds of flints, and
 “ one pound of zaffer; calcine and fuse this composition.”

Another preparation of a Blue Glazing.

“ Take four ounces of red lead, three ounces of powdered
 “ flints, one ounce of zaffer, half an ounce of tartar, and one
 “ ounce of white glass; fuse the mixture, and proceed as with
 “ the others.”

Preparation of a Violet Blue Glazing.

“ Take twelve parts of tartar, and an equal quantity of
 “ flints and zaffer; proceed as with the above.”

There is undoubtedly some error in this, since the
 vitrification can be produced by such a composition in
 these proportions.

Another preparation of a Violet Blue Glazing.

“ Take four ounces of tartar, two ounces of red lead, five
 “ ounces of powdered flints, and half a dram of magnesia;
 “ proceed as with the above.”

Preparation of a fine Red Glazing.

“ Take three pounds of antimony, three pounds of red lead,
 “ and one pound of rust of iron; grind the whole as fine as
 “ possible, and then paint with it.”

Another similar preparation of a Red Glazing.

“ Take two pounds of antimony, three pounds of red lead,
 “ and one pound of calcined saffron of Mars; proceed as with
 “ the above.”

Another preparation of a Red Glazing yet finer.

“ Take pieces of white glass, and reduce them to an im-
 “ palpable powder: Take afterwards vitriol calined to red-
 “ ness, or rather the caput mortuum which is left after
 “ the distillation of the oil of vitriol. Edulcorate the cal-
 “ cined vitriol, or caput mortuum, by washing with water
 “ to free it from the salts, and then mix as much of this
 “ calcined vitriol as there may be occasion for with the pow-
 “ dered glass. By this means a very fine red will be ob-
 “ tained, that may be used for painting, after which the
 “ work must be burnt.”

The scarlet ochre, which is the same thing with what
 Kunckel here intends by the calcined vitriol, is the best.

of the kind that can be used for this purpose, and the manner of preparing it, in the most cheap and easy manner, is taught in the first volume of this work, p. 56. But, after all, this colour will be only a foul orange red, such as is commonly found in the old China ware.

Preparation of a Brown Purple Glazing.

“ Take fifteen parts of red lead, eighteen parts of powdered flints, one part of magnesia, and fifteen parts of white glass; grind the mixture thoroughly well, then fuse it.”

Preparation of a Brown Glazing.

“ Take of red lead and flints, each fourteen parts, and of magnesia two parts, and fuse them.”

Another preparation of a Brown Glazing.

“ Take of red lead twelve parts, and of magnesia one part; fuse them, and they will produce a glazing very soft or easy to be melted.”

Preparation of a Brown Glazing to be laid on a White Ground.

“ Take of magnesia two parts, and of red lead and white glass, each one part; fuse the composition twice.”

Preparation of an Iron-coloured Glazing.

“ Take fifteen parts of red lead, fourteen parts of sand or flints, and five parts of calcined copper; calcine and fuse the mixture.”

The copper must be only calcined to redness, and the fusion must be very shortly continued, otherwise a green, and not iron colour will be produced. Indeed I believe it is highly difficult to procure such a coloured glazing by this means.

Another preparation of a Glazing like the preceding.

“ Take twelve parts of red lead, seven parts of flints,
“ seven parts of calcined copper; proceed as with the last.”

Preparation of a Black Glazing.

“ Take eight parts of red lead, three parts of iron
“ filings, three parts of calcined copper, and two parts
“ of zaffer. This mixture, when it is fused, will pro-
“ duce a brown black; but if it be desired to be of a
“ truer black colour, the proportion of zaffer must be
“ increased.”

PART VI.

The method of preparing and moulding Papier Mache, and whole Paper, for the forming Boxes, Frames, Festoons, &c. with the manner of making the light Japan Ware.

CHAP. I.

Of the preparing and moulding the Papier Mache.

THE papier-mache is paper reduced to the consistence of a pulp by boiling and beating, till it be of such consistence, that being cast in a moist state in proper moulds, it will receive the form or impression of the figure of the mould; and being previously commixt with some gummous, or other adhesive body, will acquire a considerable tenacity and hardness, so as to retain the figure, and answer the end of wood turned or carved, or plaister cast into the same form.

The paper used for making the papier mache may be of any kind, according to the nicety required in the work, to which it is applied. For very coarse purposes, brown may be employed; and for the most nice, writing paper is best; and it is not very material whether the paper be clean or foul, or whether it be written or

printed upon, or blank, except where it might be intended to be only moulded, and not coloured, or varnished afterwards, which is seldom the case.

The gum or adhesive body used for giving the due texture to the papier mache may be gum Arabic, glue, or isinglass; but for common purposes, gum Arabic, or glue are used, isinglass being too dear; and indeed gum Arabic has an advantage over either of the other, of not shrinking near so much in drying.

The preparation of the papier mache may be as follows: "Take any quantity of paper and boil it in water, stirring it about with a wooden spatula, till it become of a pasty substance, and appear to have lost its cohesion. Pour off then the water from it, and beat it in a mortar, or such kind of machine as will have the same effect, till it be a perfectly soft and yielding pulp. Prepare in the mean time a strong gum water, by dissolving gum Arabic in water; and having pressed the greatest part of the water out of the pulp, add the gum water to it in such proportion that they may produce together the consistence of a fluid. Put them then into a proper vessel, and boil them slowly, till they form a paste of the right consistence for casting. The papier mache will then be ready prepared for working with the proper moulds; but the stiffness of the paste may be varied with advantage, according to the nature of the work. That intended for pieces where the figure is simple, and has no sharp or embossed work, requiring to be stiffer; while the embossed work, or other such as have relieved parts, should be thinner. The using glue or size instead of gum Arabic, makes a saving and will answer extremely well in the case of boxes, or any other pieces of a simple or flat form, because the shrinking may be allowed for in the figure of the moulds; but for embossed work, or designs where several parts must be joined together, the use of gum Arabic will be found more expedient, as the relative proportions will be much better preserved."

The moulds in which the papier mache is cast may be either of plaister of Paris, or wood. For embossed work, or designs of a more complex kind, plaister is

preferable; but for boxes, cups, or simpler forms, the moulds may be best of wood; as such will last for a long time, and not require renewing so often, from the unavoidable wear, or the injury of a slight accidental violence, as those made of plaister. But in the choice of moulds, and subjects to which they are applied, regard should be had to the figure, with respect to its roundness or projecting parts; for embossed work or frames of any kind, where there are a variety of angles on one side, and a flat plainness on the other, are most expediently managed in plaister; but where there are nice joints, as in the case of boxes, or where the figure must be preserved on both sides, wood is much more proper. The plaister moulds for casting the papier mache must be made in the same manner as those for casting in plaister, for which ample directions are given in the first volume of this work, p. 273, and the following; and the manner of casting, likewise, may be the same as is practised for the plaister, which is also explained there, p. 275. But it is peculiarly necessary, in casting the papier mache, to grease the moulds extremely well, otherwise there will be a cohesion betwixt the matter cast and the moulds, that will be destructive to both. Where any subject cast is of considerable extension, and one side of it a blank reverse, as in the case of bas-reliefs, and other ornaments of that nature, it is usual to lay slips of whole strong paper over the papier mache, such paper being first well moistened with gum water, or strong size, which is rather better in this case. This not only makes a saving, but is really an advantage to the work, as it adds greatly to the strength and tenacity, and more especially preserves it, during the time of its drying, from the injuries of a slighter violence. To answer this end more effectually, the paper itself applied to this purpose should, however, be very strong, and where the nature of the subject admits of it, laid on several times doubled.

The wooden moulds, which are the most proper sort for forming boxes, cups, or flat pieces of any kind, where there is no embossed work, must be made in two parts; or more explicitly, there must be a convex part and a concave part; betwixt which a space must be al-

lowed for the figure of the subject that is to be cast. These may be made best of box, or other hard wood turned into the proper figure, and it is expedient to have two or three small perforations, or holes, through the substance of the wood of the concave part near the middle, to let out the fluid when the papier mache is compressed, to give it the due form. The hollow betwixt the convex, and concave parts of the mould may be about a seventh or eighth part of an inch thick, in the case of snuff or dressing-boxes, or other pieces of the like magnitude, but it may be enlarged when bigger subjects come in question. The moulds, when first used, should be well greased, and placed before a fire, that they may imbibe as much as possible of the grease, which will render the oiling them afterwards, each time they are employed, more effectual.

When the moulds are prepared, the surface of the concave or hollow part must be spread over with the paste as evenly as possible, and, as nearly as can be judged, of the thickness of the hollow betwixt the two parts, and then the cover or solid part of the mould must be put over the paste and compressed till it be in its proper place. The cast being thus made, it must be suffered to remain in the mould till it gain a sufficient strength and tenacity of parts, by drying, to be able to maintain its form when taken out; and then, being freed, from both parts of the mould, it must be dried and afterwards varnished or painted, according to the purpose for which it is designed.

CHAP. II.

Of the manner of Moulding, &c. the whole Paper for the forming Snuff-Boxes, Cups, &c.

THE manner of moulding the whole paper is much the same as that of the papier mache; but it can be only applied advantageously to the forming a piece where the surface is flat, and without embossed or raised work, and therefore moulds of wood are proper. The paper employed for this purpose should be the strongest brown kind; the texture should be equal, and, if any lumps or grosser inequalities are found, they should be taken off the paper. Being cut into pieces of such a figure and size as may best suit the form of the mould, it should be then moistened with gum water till it be pliable and soft, but not so soaked or macerated as to render it too weak and tender to bear adapting to the form of the mould. The slips or pieces should be then laid on the convex or solid part of the mould, which should be first well oiled. Each should then be brushed over after it is laid on with paste of a thin consistence, made by boiling flower and water for a long time, and adding afterwards about two ounces of common size to a pound of the paste. Other slips must be afterwards laid on the first in the same manner, for three or four layers, according to the thickness and strength required in the work. When there is a due thickness of the slips laid on, the hollow mould should be put over them, and pressed down to its proper place, and there continued for some time; after which it may be taken off, but the paper must not be separated from the convex or solid mould till it have a sufficient hardness to support itself in the form given to it by the mould. Snuff-boxes, and such other pieces as have lids, or are to be made in two parts with joints, must have separate moulds for the two parts, in the manner above directed for the papier mache,

but cups, saucers, or other such pieces, may be formed on solid or convex moulds only, the exterior surface being rendered even and smooth by dressing it with an ivory knife, or other instrument of the like kind, and a China or other cup already formed, may, on occasion, serve for the mould.

The boxes, cups, &c. formed of whole paper, in this manner, ought always to be afterwards coated with a good varnish, if they be intended either to bear any wear, or to contain any fluid; but, if they be intended only for the ornaments of chimney-pieces, or other such purposes, they may be painted with fat oil tempered with oil of turpentine, and mixed with any pigment of the colour that is desired to be given them.

CHAP. III.

Of the manner of preparing the Matter, and Moulding the light Japan-Ware.

“TAKE saw-dust of fir-wood, and sift off, by the use of two sieves of different fineness, all the most gross parts and the smallest. Melt then equal parts of resin and turpentine, with a half-part of bees-wax, and put into the melted mixture as much of the saw-dust as can be added without rendering the mass of a thicker consistence than can bear to be powdered. Stir the saw-dust and melted matter together till they be thoroughly mixt, and then cast them after in proper moulds. If it be desired to render the matter harder, a little shell-lac or gum sarcocol may be added in powder to the mixture; but this must not be done before the saw-dust be well united with the other ingredients, and the matter should be kept no longer on the fire afterwards than may be necessary for melting and mixing the shell-lac or gum sarcocol with

“with the rest. The whole of this mixture should be used at one time, for it cannot be brought to a proper state for casting, by being re-heated, without damaging it by burning.”

The cups, boxes, or other vessels formed of this matter, ought to be cast in double moulds, like the papier mache, which may be made of wood turned, or of lead, pewter, or other metals; but care should be always taken to grease the moulds very carefully; or otherwise this matter being very adhesive, will glue the parts together, so that they cannot be separated without difficulty. The cups formed of this matter may be made thin, as it is very tenacious, and they will be extremely light.

This composition is not superior to the papier mache, or the whole paper, for making snuff-boxes, or other such pieces as are not to contain fluids; but for cups, saucers, and such vessels as are required to bear moisture, it is far preferable; and, when varnished in a proper manner, is more elegant than China, with the advantage, from its lightness, of not heating so as to burn the lips, as vessels of heavier matter are subject to do.

C H A P. IV.

Of the Painting, Gilding, and Varnishing the Snuff-Boxes, Cups, &c. formed of the Papier Mache, the whole Paper, or Saw-Dust.

THE manner of painting the snuff-boxes, or other such pieces, formed of the papier mache, the whole paper, or saw-dust, may be the same as in other japanned work; for which directions are given in the first volume of this work: But where it is desired that they should bear much rubbing and wear, the use of

the shell-lac varnish, as a vehicle for the colours, managed according to the method described in the first volume of this work, is much the most effectual. The painting in oil, or in the varnish compounded of oil, and the sandarac or mastic, according to the directions in the first volume of this work, p. 166, is however more easy and expeditious, where the durableness of the work is not of great moment; but the colours should in that case be tempered thin, that they may be laid on so as not to raise any inequality in the surface, to prevent the varnish laid over them from taking a proper polish.

In the French manner of japanning the papier mache, the old method is pursued of laying a ground under the colours and varnish of whitening and size; but in the Birmingham manufacture of the same articles, this is omitted, and very advantageously with respect to the durableness of the pieces; for the coats of colour and varnish are apt to crack with any violence, on account of their not having a firm and tenacious substance under them; and this occasions their peeling, and suffering large flakes to separate from the ground, when the least impression or crack has been made on the edges, or any other part. The different treatment of japanned work under either of these methods, with a more particular account of their nature, and the reason why the English and French manufactures differ in this particular, are so explicitly touched upon in p. 320 of the first volume of this work, that it is needless to enlarge further on them here.

The varnish employed for the pieces formed of papier mache, whole paper, or saw-dust, may be likewise the same as in any other kind of japanned work; for which directions will be found, p. 329, of the first volume of this work. The most durable is the seed-lac varnish, which may be either that made of the picked grains, for which the recipe is given, p. 324, of the first volume of this work, the common kind, as in p. 331, or the cheaper sort, as in p. 324, according to the occasion. But for the pieces that are not subject to much rubbing or violence, the Florentine varnish given in this volume, p. 81, may be employed, as it is both cheaper; and saves the labour of polishing.

The gilding may be also performed by the same means as are used for other Japan work, which are taught in the first volume of this work, p. 333; but where the whole is gilt for a ground to the painting, the gold size should be diluted copiously with oil of turpentine, and laid on as thin as possible.

When the painting, gilding, varnishing, &c. is performed, it is proper in all cases, where great firmness and hardness of the varnish is required, to bake the pieces in a proper stove, beginning with a gentle heat, and increasing the degree to the greatest that can be given without changing the colour of the varnish, or the painting, by burning them. But this is more particularly requisite in the case of cups and saucers made of the whole paper, or saw-dust, which are to bear hot water; for there baking them a considerable time, in a strong heat, renders the varnish proof against any injury that could be done to it, even by boiling water.

The true Japan black laquer (which is now frequently brought from China) has been sometimes used for the varnishing snuff-boxes, cups, and all such pieces made of the paper or saw-dust. But this laquer, being the concreted juice of the toxicodendron tree, its poisonous qualities are almost constantly fatal to those who work with it for any length of time, and sometimes even on very slight intermeddling with it. Such a momentous inconvenience, together with the tediousness of despatching the work, on account of its great tardiness in drying, being extremely good reasons against its use, it is much more advisable to employ the common kinds of varnish, which, when managed judiciously, may be rendered nearly both as beautiful and durable, without either the danger or the difficulty attending the other.

When the true Japan varnish is however used, all heat must be avoided; for, contrary to the nature of most other substances of the same kind, this dries best when most exposed to moisture, and can indeed only be brought to a proper state of hardness by keeping it in some place which is either naturally damp, or made so artificially.

A P P E N D I X;

CONTAINING

Several supplemental Articles, belonging in
some manner to heads before treated of,
either in the first or second volumes.

Of the method of preparing and colouring Marbled Paper.

THERE are several kinds of marbled paper, but the principal difference of them lies in the forms in which the colours are laid on the ground, some being disposed in whirls or circumlocutions, some in waving jagged lengths, and others only in spots of a roundish or oval figure. The general manner of managing each kind is nevertheless the same, being the dipping the paper in a solution of gum tragacanth, (or, as it is commonly called, gum dragon) over which the colours, previously prepared with with ox-gall and spirit of wine, are first spread.

The peculiar apparatus necessary for this purpose is a trough for containing the gum tragacanth and the colours, a comb or quill for disposing them in the figure usually chosen, and a burnishing stone for polishing the paper. The trough may be of any kind of wood, and must be somewhat larger than the sheets of paper for

marbling which it is to be employed; but the sides of it need only rise about two inches above the bottom, for, by making it thus shallow, a less quantity of the solution of the gum will serve to fill it. The comb may be also of wood, and five inches in length, but should have brass teeth, which may be about two inches long, and placed at about a quarter of an inch distance from each other. The burnishing stone may be of jasper or agate, but as those stones are very dear, when of sufficient largeness, marble or glass may be used, provided their surface be polished to a great degree of smoothness.

These implements being prepared, the solution of gum tragacanth must be made, by putting a sufficient proportion of the gum, which should be white and clear from all foulnesses, into clean water, and letting it remain there a day or two, frequently breaking the lumps and stirring it till the whole shall appear dissolved and equally mixt with the water. The consistence of the solution should be nearly that of strong gum water used in miniature painting; and, if it appear thicker, water must be added, or, if thinner, more of the gum. When the solution is thus brought to a due state, it must be passed through a linen cloth, and being then put into the trough, it will be ready to receive the colours.

The colours employed for red are carmine, lake, rose-pink, vermilion, and red lead; but the two last are too hard and glaring, unless they be mixt with rose-pink, or lake, to bring them to a softer cast; and with respect to the carmine and lake, they are too dear for common purposes;—for blue, Prussian blue and verditer may be used;—for yellow, Dutch pink and yellow ochre may be employed;—for green, verdigrise, a mixture of Dutch pink and Prussian blue, or verditer, in different proportions;—for orange, the orange lake, as directed to be prepared page 99 of the first volume of this work, or a mixture of vermilion, or red lead, with Dutch pink!—for purple, rose-pink and Prussian blue.

These several colours should be ground with spirit of wine till they be of a proper fineness, and then at the time of using them a little fish-gall, or, in default of it the gall of a beast should be added, by grinding them

over again with it. The proper proportion of the gall must be found by trying them, for there must be just so much as will suffer the spots of colour, when sprinkled on the solution of gum tragacanth, to join together, without intermixing or running into each other.

When every thing is thus prepared, the solution of the gum tragacanth must be poured into the trough, and the colours, being in a separate pot, with a pencil appropriated to each, must be sprinkled on the surface of the solution, by shaking the pencil, charged with its proper colour over it; and this must be done with the several kinds of colour desired till the surface be wholly covered.

Where the marbling is proposed to be in spots of a simple form, nothing more is necessary, but where the whirls or snail-shell figures are wanted, they must be made by means of a goose-quill, which must be put among the spots to turn them about till the effect be produced. The waving jagged lengths must be made by means of the comb above described, which must be passed through the colours from one end of the trough to the other, and will give them that appearance; but if they be desired to be pointed both ways, the comb must be again passed through the trough in a contrary direction; or if some of the whirls or snail-shell figures be required to be added, they may be yet made by the means before directed.

The paper should be previously prepared for receiving the colours by dipping it over-night in water, and laying the sheets on each other with a weight over them, in the same manner as was before described, in p. 141, in the case of paper to be imprinted by copper-plates. The whole being thus ready, the paper must be held by two corners, and laid in the most gentle and even manner on the solution covered with the colours, and there softly pressed with the hand, that it may bear every where on the solution; after which it must be raised and taken off with the same care, and then hung to dry cross a proper cord, subtended near at hand for that purpose, and in that state it must continue till it be perfectly dry; it then remains only to give the paper a polish, in order to which it is first rubbed with a little

soap, and then must be thoroughly smoothed by the glass polishers, such as are used for linen, and called the calendar glassies; after which it should be again rubbed by a burnisher of jasper or agate; or, in default of them, of glass ground to the highest polish; for on the perfect polish of the paper depends, in a great degree, its beauty and value.

Gold or silver powders may be used, where desired, along with the colours, and require only the same treatment as them; except that they must be first tempered with gum water.

Method of taking off Paintings in Oil, from the Cloth or Wood on which they were originally done, and transferring them entire, and without damage to the new Pieces.

THE art of removing paintings in oil from the cloth or wood on which they are originally done, and transferring them to new grounds of either kind of substance, is of very great use. Not only pictures may be preserved, where the canvas is so decayed and damaged, that they would otherwise fall to pieces, but paintings on ciplings or wainscot, which, when taken away from the places where they were originally placed, would have little value, may be conveyed to cloths; and, by being thus brought to the state of other pictures, become of equal worth with those painted originally on canvas. The manner in which this is done is, by four successive operations. The first is, the cementing the face of the picture to a new cloth, by means of such a substance as will admit of being afterwards dissolved in water, in order to its being taken off. The second is, by destroying the texture of the old cloth, by means of a proper corroding fluid, in such manner, that it may be separated from the painting, and the making such pre-

paration accordingly. The third is, the cementing a new cloth to the painting, in the place of the old one now taken away. The fourth is, the corroding, and subsequently taking away, the cloth cemented to the face of the picture, and the cleansing away the cement, or any remains of the cloth, by water, which, dissolving the cement, renders it capable of being rubbed off from the face of the picture. The particular method of performing these several operations is as follows:

Let the decayed picture be cleansed from all grease that may be on its surface, which may be done by rubbing it very gently, with a crumb of stale bread, and then wiping it with a very fine soft linen cloth. It must then be laid with the face downwards, on a smooth table covered with fan paper, or the India paper, and the cloth on the reverse must be well soaked with boiling water, spread upon it by means of a sponge, till it appear perfectly soft and pliable. The picture is then to be turned with the face upwards, and, being stretched in the most even and flat manner on the table, must be pinned down to it in that state, by nails driven in through the edge, at proper distances from each other. A quantity of glue should be then melted and strained through a flannel cloth, to prevent any gravel or other impurities from lurking in it, and, when it is a little stiffened, a part of it should be spread on a linen cloth, of the size of the painting, where it should be suffered to set and dry, and then another coat put over it. When this is become stiff also, the glue should be again heated, and while it remains of such heat as to be easily spread, it should be laid over the face of the picture, and the linen cloth, on which the glue was before spread, immediately put over in the most even manner, and nailed down to the picture and table at the edge likewise. The glue should not be used boiling hot, as that would hazard some of the more delicate colours of the painting; and the linen cloth should be fine and half worn, that it may be the softer, and lie the flatter on the surface of the picture; in order to which it is proper to heat it till the glue be soft and pliable before it be laid on, and to compress each part gently with a ball formed of a linen rag tied round with thread. The

table, with the picture, cloth, &c. nailed down to it in this state, should be then exposed to the heat of the sun, in a place where it may be secured from rain, and there continued till the glue be perfectly dry and hard, at which time the nails should be drawn, and the picture and linen cloth taken off from the table. The picture must now be again turned with the face downwards, and stretched and nailed to the table as before, and a border of wax must be raised round the edge, in the same manner as is directed for the copperplates, p. 118, forming as it were a shallow trough with the surface of the picture; into which trough should be poured a proper corroding fluid to eat and destroy the threads of the original canvas or cloth of the picture. The corroding fluid used for this purpose may be either of oil of vitriol, *aqua fortis*, or spirit of salt; but the last is preferable, as it will more effectually destroy the thread, when it is so weakened by the admixture of water, as not to have any effect on the oil of the painting. Whichever is used, it is necessary they should be properly diluted with water; to find the due proportion of which, it is expedient to make some previous trials, and when they are found to be of such strength as to destroy the texture of the thread without discolouring it, they are in the due state. When the corroding fluid has done its office, a passage must be made through the border of wax at one end of it, and the fluid must be poured off, by inclining the table in the requisite manner; and the remaining part must be washed away, by putting repeated quantities of fresh water upon the cloth. The threads of the cloth must then be carefully picked out till the whole be taken away; but if any part be found to adhere, all kind of violence, even in the least degree, must be avoided in removing them; instead of which, they should be again touched, by means of a pencil, with the corrosive fluid less diluted than before, till they will readily come off from the paint. The reverse surface of the painting being thus wholly freed from the old cloth, must be then well washed with water, by means of a sponge, till the corroding fluid employed be thoroughly cleansed away; when being wiped with a soft sponge, till all the moisture that may be collected by that means be taken off,

it must be left till it be perfectly dry. In the mean time, a new piece of canvas must be cut of the size of the painting which now remains cemented to the linen cloth put on the face of it; then the reverse of the painting being dry, and spread over by some hot glue, purified as before, and melted with a little brandy or spirit of wine, the new canvas must be laid on it, in the most even manner, while the glue yet remains hot and settled to it by compression, which may be performed by thick plates of lead, or flat pieces of polished marble. Great care should however be taken in the laying them on, to prevent the edge from cutting or bruising the paint, as also, during the setting of the glue, to take them off, and wipe them at proper intervals, to prevent their adhering to the cloth by means of the glue, which may be pressed through it. The lead or marble, by which the compressure is made, being removed when the glue is set, the cloth must be kept in the same state till the glue be perfectly dry and hard. Then the whole must be again turned with the other side upwards, and the border of wax being replaced, the linen cloth on the face of the painting must be destroyed by means of the corroding fluid, in the same manner as the canvas was before; but greater care must be taken with respect to the strength of the corroding matter, and in the picking out the threads of the cloth, because the face of the painting is defended only by the coat of glue which cemented the linen cloth to it. The painting must then be freed from the glue, by washing it with hot water, spread and rubbed on the surface by a sponge, which should be cleansed frequently during the operation by dipping and squeezing it in clean water. The painting may afterwards be varnished as a new picture; and, if the operation be well conducted, it will be transferred to the new cloth in a perfect state.

When the painting is originally on wood, it must be first detached from the ceiling or wainscot where it was fixed, and the surface of it covered with a linen cloth, cemented to it by means of glue, in the manner before directed for the paintings on canvas. A proper table being then provided, and overspread with a blanket, or thinner woollen cloth, if laid several doubles, the paint-

ing must be laid upon it with the face downwards, and fixed steady, and the boards or wood on which it was done must be planed away, till the shell remain as thin as it can be made, without damaging the paint under it. The proceedings must afterwards be the same as was before practised in the case of the paintings on canvas, till that on the wood be in like manner transferred to a cloth or canvas.

The whole of the above operation must be managed with the greatest care, otherwise the painting will receive some damage; and so much nicety is required in the corrosion, and taking off the threads of the cloth, that it can scarcely be performed rightly but by such as have had some experience in the matter. It is proper, therefore, for any person who would practise it in the case of valuable paintings, to try it first with some old pictures of little value, till they find they have the right method of proceeding; and even then, in some instances, where the coats of paint lie very thin on the cloth, it is scarcely practicable without miscarriage. But as, in the case of pictures greatly decayed, or paintings on wood taken from buildings that do not admit of being commodiously replaced elsewhere, there can be no great loss, if a failure should happen; and a considerable advantage may accrue, if the experiment succeed, for which there is a good chance, if the operation be properly conducted, and the subject favourable. It is very well worth while to make the trial.

The original recipe for the making Prussian Blue, as published by Dr. Woodward.

“**T**AKE any quantity of blood, and evaporate it to dryness, continuing the heat till it become black, but avoiding the burning any part of it to ashes. Powder the dry matter, and mix it thoroughly

“ with an equal weight of pearl-ashes, and calcine the
“ mixture in an iron pot or crucible, on which a cover
“ is put. The calcination must be continued so long
“ as the matter emits any flame, the fire being raised
“ to a considerable degree of heat at the end of the
“ operation, and the matter must be then powdered,
“ and put, while yet hot, into twelve times its weight
“ of water, which must be again set on the fire to boil
“ for the space of three quarters of an hour or more.
“ The fluid must then be filtered off through a thin
“ flannel bag, from the part remaining undissolved;
“ through which remaining part fresh water should be
“ passed, before it be taken out of the filtering bag, to
“ extract as much as possible of the solution; and the
“ water, thus passed through, should be added to the
“ quantity before filtered; after which, what is retain-
“ ed in the bag may be thrown away. In the mean
“ time a solution should be made of alum and copperas
“ calcined to whiteness, in the proportion of two pounds
“ of the alum, and two ounces of the calcined vitriol,
“ to each pound of the pearl-ashes used with the blood,
“ which solution must be made by boiling the alum and
“ copperas in five times their weight of water, and then
“ filtering them through flannel or paper, where great
“ nicety is required. When the solution of the alum
“ and copperas is thus prepared, it must be added to
“ the lixivium filtered off from the calcined blood and
“ pearl-ashes, from which mixture the precipitation of
“ a blackish green matter will soon ensue. After the
“ precipitated matter has subsided to the bottom of the
“ vessel, and the fluid appears clear over it, separate
“ it from the green sediment, first by pouring off all
“ that will run clear out of the vessel, and afterwards
“ by straining off the remainder, and then put the green
“ matter again into a vessel that will contain as much
“ fluid as it was before mixt with. Add spirit of salt
“ to it afterwards, in the proportion of six ounces to
“ every pound of the pearl-ashes used, and the green
“ matter will then soon appear to be converted into a
“ beautiful blue. Water must then be added to wash
“ off the spirit of salt, which must be renewed several
“ times till it come off perfectly sweet, and the last

“ quantity must then be strained off, and the blue sediment dried in lumps of a moderate size. The produce will be about three ounces for every pound of the pearl-ashes employed.”

This recipe was omitted in the first part of this work for want of room, and another inserted where the proportions of the ingredients are more accurately adapted to each other, in order to make a saving in the expence. But this recipe will produce an equally fine colour, and if the produce be desired to be made either of a lighter or darker hue, it may be done by increasing the proportion of the pearl-ashes to the blood to give a lighter kind, or the spirit of salt to the pearl-ashes to give a deeper kind; but the quantity will in the latter case be proportionably diminished.

The straining or filtering the lixivium through flannel is not so good a method as the doing it through paper, especially where the colour is wanted of a very great brightness and purity, and the water is best separated from the great sediment first produced, and afterwards from the blue one by the same means; but in these cases a fine linen cloth much worn, though whole, should be laid over the paper. The colour, when reduced to a proper consistence, may be laid on chalk-stones to dry, and a moderate heat may be also used for greater expedition, when required; but great care should be taken not to burn the matter. The calcination may be performed in a reverberatory furnace, such as is used by the chymists, or in the furnaces where metals are melted; for the crucible or pot containing the matter may either be surrounded by the coals, or placed over them, provided a sufficient heat be given to it. But where larger quantities are to be calcined, they may be very cheaply and commodiously managed in the potters' or tobacco-pipe makers' furnaces, being put into them along with the earthen ware and pipes. And if the calcined matter in such case cannot be conveniently powdered while hot, and put into water, the deviating from that part of the process may be dispensed with, nor being absolutely necessary, if the matter be well powdered afterwards, before it be put into the water.

Of light Red, or light Ochre, (*which should have been inserted, p. 68, of the first volume of this Work.*)

THIS pigment is an ochre of a light red colour, of the scarlet cast, which is very useful in carnations, and for many other purposes. It may be had of the colourmen, or may be made by calcining the yellow ochre till it acquires the tint of orange or red desired. After the calcination, it must be ground and washed over, and then dried, either by heat or without, as may be most expedient. But when it is had of the colourmen, it is generally already ground and prepared for use; though, as they are not so nice in common as to wash over the colours, that operation may be added to what they have done, where the ochre is desired to be perfectly fine.

The method of foliating or silvering Looking-glasses.

THE foliating looking-glasses is performed by fixing quicksilver on the reverse surface, by means of plates of tin; which, amalgamating or combining with the quicksilver, takes away its fluidity, and renders it so tenacious as to be compressed into a very thin coat or plate, capable of adhering to the surface of the glass.

There are several manners of laying the quicksilver and tin on the glass; and it is by some practised, to use the quicksilver alone; and by others, to compound with it tin and lead; and bismuth has likewise been frequently used instead of them; but it is not necessary, when the operation is well conducted, to make any ad-

dition to the quicksilver. The following is one of the best methods hitherto practised.

“ A proper number of sheets of thin paper must be procured ; which paper should be of a soft spongy nature like that called blotting paper. This paper must be spread on a table with a very level even surface, and fixed very firmly ; or it is better to use a marble table or slab. But so much only of the table should be covered as may form an area of the same figure with that of the glass to be silvered, a little enlarged. Over the surface of the paper must be sprinkled some powdered chalk, which should be well levigated, and wholly clear of any gravel or impurities. Leaves of tin, which should be rolled or beaten very thin, must then be laid upon the paper sprinkled with chalk, in the most smooth and even manner ; and where there is occasion on account of the size of the glass, to use more than one, they should be joined with great exactness, (rather suffering nevertheless the edge of one to bear on the other, than leaving any deficiency) so that the whole surface of the paper may be perfectly covered. Quicksilver is to be then poured upon these leaves of tin, and spread over every part of it by a hare's foot, or the feathered part of a quill. Some sheets of very thin smooth paper, of which the kind called fan paper is best, must be then spread over the quicksilver, leaving a margin beyond the quicksilver, and upon this paper the glass must be gently laid, and then, being pressed down with the one hand, the sheets of the thin paper must be gently drawn from under it with the other, by taking hold of the margin left for that purpose. The upper surface of the glass must then be covered with thick paper, and a considerable weight put over it, in order to press out all the quicksilver that is not fixed by the tin, as well as to make it adhere the more firmly to the glass. When no more quicksilver appears to drain off, the weights and paper may be removed, and the operation will be completed.”

Some who use the bismuth add half an ounce of it to an ounce of the quicksilver. They make an amalgamation of them by melting the bismuth, and having

taken it off the fire, putting in the quicksilver gradually, and stirring it with an iron rod, or tobacco pipe, till the whole be thoroughly incorporated, pouring afterwards the mass into cold water to prevent the quicksilver from subliming with the remaining heat. It is proper, nevertheless, before this composition be used, to strain it through a cloth, and what remains, and will not be pressed through, may be added to the next quantity to be incorporated. The proportion of tin and lead, when they are used in the same manner, is generally a compound of equal parts, in the proportion, when together, of a fourth-part of the weight of the quicksilver. It has been also formerly practised to use a composition of two parts of bismuth, and one part of tin, with the same quantity of lead, and ten parts of the quicksilver.

Where the glasses with angular surfaces, called diamond cut, are to be silvered, a border must be formed on the table of the figure of the glass, which may be done by a moveable frame. The paper, leaves, &c. must be brought over this border, and the subsequent proceeding may be the same as in the case of the plain surface, only taking great care that the glass be properly let down within the border, so as to bear every where both on that and the surface of the table.

Globes of glass may be silvered; but as no pressure can be given, the plates of tin cannot be used, and the quicksilver must therefore be rendered of a proper consistence, by amalgamating it with some of the other metallic substances. The most approved method of doing this is as follows:

“ Take of quicksilver two parts, of bismuth two
“ parts, and of tin and lead each one part: Melt the
“ tin and lead together, and, when they are fluid, add
“ the bismuth. When that is melted likewise, take
“ them from the fire, and put the quicksilver gradually
“ to them, stirring the mixture till the whole be united.
“ After the mass is become so cool as not to endanger
“ its breaking the glass, pour it into the globe to be
“ silvered, using a funnel, which will carry it to the
“ bottom of the globe. Move the glass then gently
“ about, so that the amalgamated matter may flow over
“ every part, and adhere to it, which will effectually

“silver the globe. Whenever part is covered, pour
 “out the redundant quality, and keep the glass still till
 “it be perfectly cool. If, during the operation, the
 “mixture appear to set in the globe, and be not suffi-
 “ciently liquid to flow about and cohere with the glass,
 “a gentle heat must be administered, which will reme-
 “dy this defect; and if, on the contrary, the matter
 “appear too fluid, and have not sufficient tenacity to
 “fix itself to the glass, it must be taken out, and an
 “additional quantity of the bismuth, tin, and lead,
 “added by means of a proper heat.”

As it is very advantageous for those that have occasion to silver considerable quantities of looking-glasses to know how to separate the quicksilver from the tin; or other ingredients, I will subjoin the directions for doing it in a very expedite and quick manner, with the assistance of a common fire, by means of an alembic or still, that may be constructed in the following manner:

Let a copper or iron pan be first made, of about ten inches diameter, and about four or five inches depth. Over this let a cover be soldered on it, in which cover must be fixed a short tube for the pouring in the quicksilver, and taking out the recrement after the operation. This tube must have a stopper capable of being screwed into it, so as to render the joint good against any escape of the vapour of the quicksilver, when raised with the pan. In the upper part of the side of the pan must be soldered a gun barrel, of about four or five feet in length, in a sloping direction; the hollow of which barrel must communicate with the cavity of the pan, so that the fumes of the quicksilver may pass into it. The end of this barrel must be also bent downward, so that when the pan is placed in a level situation on the fire, this end of the tube may be immersed in the vessel of water, placed aptly for that purpose. This vessel may be a common pail or large earthen pan, or any other such, which will contain a gallon or more of water. When this apparatus is provided, the operation is to be performed in the following manner:

“Take any quantity of the matter from which the
 “quicksilver is to be separated, and put it into the

"copper or iron alembic or pan, and screw down the
 "stopper in the hole of the tube through which the
 "matter is put in. Place the pan then upon the burn-
 "ing coals in a common fire, raising the coals round
 "the side, and bring the vessel of water under the bent
 "end of the gun barrel, so that an inch or two of it
 "may be within the water. The quicksilver will soon
 "rise in fumes, which, passing into the barrel, will be
 "condensed there, or on the surface of the water at
 "the end of it, and will flow in drops into the water,
 "and be collected at the bottom of the vessel. When
 "the whole of the quicksilver first put in is thus brought
 "over, which may be easily perceived by the cooling
 "of the barrel, and the drops ceasing to fall into the
 "water, the stopper in the small tube at the top may
 "be taken out, and a fresh quantity of the matter put
 "in; and the same may be repeated as often as there
 "may be occasion."

"When all the quicksilver is distilled over, the wa-
 "ter may be poured from it out of the vessel; and
 "being put into a basin, or other small vessel, it may
 "be freed from the remaining moisture, by means of
 "a sponge. The tin, lead, &c. may likewise be taken
 "out of the alembic or pan, when it is grown cold."

Varnish proper for Pales and coarse Wood- work.

"TAKE any quantity of tar, and grind it with as
 "much Spanish brown as it will bear, without
 "rendering it too thick to be used as a paint or var-
 "nish, and then spread it on the pales, or other wood,
 "as soon as convenient, for it quickly hardens by keep-
 "ing."

This mixture must be laid on the wood to be varnish-
 ed by a large brush, or house-painter's tool; and the
 work should then be kept as free from dust and insects

as possible till the varnish be thoroughly dry. It will, if laid on smooth wood, have a very good gloss, and is an excellent preservative of it against moisture; on which account, as well as its being cheaper, it is far preferable to painting, not only for pales, but for weather boarding, and all other kinds of wood-work for grosser purposes. Where the glossy brown colour is not liked, the work may be made of a greyish brown, by mixing a small proportion of white lead, or whiting and ivory black, with the Spanish brown.

Preparation of Ivory for a ground for Miniature Painting, omitted in the first volume of this Work, p. 198.

“**T**AKE the ivory leaves, or tables on which the painting is to be made, and, having cleansed it, rub it over with the juice of garlic.”

This takes off that greasiness which is so much complained of, as preventing the colours from taking on the ground, and which is not otherwise to be remedied by the use of soap, or even gall. It is, however, effectually removed by this expedient, which was imparted to a gentleman by a lady eminent for her painting in this way in Italy, and by him to me, since the publication of the first volume of this work.

Method of Weaving Tapestry.

THERE are two manners in which tapestry is wove; the one is called the *high warp*, the other the *low warp*. The work produced is, nevertheless, much the same, and the difference betwixt the two kinds consists principally in this, that, in the high warp, the loom is

placed in a perpendicular position, and in the low warp horizontally. The high warp was formerly mostly practised, but at present it is much neglected, principally on the account of the greatly slower progress made in the work by this method than the other. The mark of difference, by which pieces may be distinguished to be of either kind, is this, that in the low warp there is a red fillet of about an inch broad, running from top to bottom; which fillet is never found in the high.

The low warp being the most used, and consequently the most important at present, I will first give the method of working in that way, and then subjoin the manner of working with the high warp, for the satisfaction of those who may be desirous, notwithstanding the present neglect of it, to understand that also.

The apparatus, or set of utensils for the low warp, are, the loom, the *flute*, and the *needle* or *comb*.

The loom is constructed much in the same manner as that of the weavers of cloth. The principal parts are two strong pieces of wood forming the sides of the loom, and bearing a beam or roller at each end. These pieces are supported with other long ones at the bottom, in the manner of treadles; and, in order to fix them more firmly, and to keep them steady, they are fastened to the floor as a kind of buttresses, to prevent their moving, which must otherwise be very incommotions, as there are sometimes five or six workmen leaning on the beam at once. The rollers have each of them trunnions, by which they are supported; and these trunnions are turned by large iron levers or pins three feet long. In each beam is made a groove for the whole length, for containing the wick, which is formed of a piece of wood of two inches diameter, and almost of the length of the roller. This wick fills the groove entirely, and is fixed to it by several wooden pins placed at proper distances. The use of the wicks is for fastening the piece of tapestry as it is wrought, so that it may be wound on one roller at first, and then be drawn off by the other as the work advances. Across the two sides, almost in the middle of the loom, a wooden bar is placed, which supports little pieces of wood, resembling the beam of a balance; and to these pieces are fastened strings, that

bear spring staves, by which the workman gives a motion to the coats, by setting his feet on two treadles placed under the loom, and by this means makes the threads of the warp fall and rise alternately.

The coats are short pieces of string, which are fastened to the spring staves, in order to fix the threads of the warp to it by means of sliding knots; a greater or less number of these spring staves, and a greater or less number of coats to each staff, are put on the loom, according to the nature of the piece of tapestry to be wrought, with respect to its consisting of a greater or less number of threads.

The flute is an implement corresponding to the shuttle in the ordinary looms. It is made of hard polished wood, three or four lines thick at the end, somewhat round in the middle, and of three or four inches in length. The use of it is to carry the silk, worked, or other matter employed as the woof of the tapestry, which is wound on it.

The needle or comb is made either of wood or ivory. It has generally teeth on both sides, and is about an inch thick in the middle, but diminishing each way to the extremity of the teeth. The intention of it is to beat the threads of the woof close to each other, when the weaver has passed and placed them with his flute among the threads of the warp.

The loom being put together, the weaver first lays the design under the loom in such manner as may correspond exactly with the work; and then proceeds to fix the threads that form the warp, which is done by fastening them at each end to the two wiches in the grooves of the roller.

The loom being thus set, all the coloured silk or worsted to be employed in the design (being wound each kind on their proper flutes, in order to their forming the woof) must be put in baskets, and placed within reach; and the weaver then sets himself on a bench before the loom, with his breast leaning against the beam, on which a cushion is placed for that purpose. Being thus seated, he inspects the design fixed under the warp, by moving away, or separating the threads with his finger, which must be repeated from time to time, as

often as there may be occasion during the progress of the work. Then he takes the flute on which the colour first required is wound, and passes it among the threads of the warp, according to the design, after having raised them by putting his feet on the treadles, which move the proper spring flaves and coats. Having thus passed the flute across, through the threads of the warp, to the extremity of the further side, he returns back in the same manner, where the work admits of it; and then he presses together, and closes the threads of this course with those of the last, by means of the reed or comb with which he strikes the threads, till they gain their due place. And this is to be done every course, whether it be double, by passing the woof from one side to the other, and then back, or to one side only. In the same manner the weaver must proceed till the whole be finished, shifting the warp according to his convenience, by taking such part as is wrought on the further roller, and winding off the same proportion from the nearest to him, accommodating, at the same time, the design, by shifting the parts through the means of the strings by which it is hung under the warp.

There is a remarkable disadvantage attends this manner of weaving, which is, that the weaver works as it were blindfold, the whole being done on the wrong side the tapestry, and not admitting of any view or inspection till all the piece be finished. It is, indeed, the same, with respect to the working, in the case of the high warp; but there the weaver may, whenever he pleases, by going round, see what he has done, and judge of the effect in every critical instance.

The apparatus for weaving tapestry in the high warp consists of the *loom*, the *brouch*, the *reel* or *comb*, and the *needle*.

The loom, which, as was before observed, is set perpendicularly, is formed of four principal pieces, viz. two long planks or cheeks, and two thick rollers or beams, all made of wood.

The planks are set upright, and are seven or eight feet high, fourteen or fifteen inches broad, and three or four thick. The beams are fixed across the planks, the one at the top, the other at the bottom, at about a foot

distance from the ground. These beams or rollers have each of them trunnions, by which they are suspended on the plank, and they are turned round occasionally by bars. In each of them is a groove from one end to the other, capable of containing a long round piece of wood fastened in them with hooks; the use of which hooks are to furnish a proper fastening for the ends of the warp. The intention of the upper roller is to hold the warp which is wound round it, and the use of the under one to hold the tapestry as the work advances.

Within the planks are holes that are pierced in them from top to bottom, in which holes are put thick pieces of iron with hooks at one end, serving to support the coat staves. The pieces of iron have also holes pierced in them, by putting a pin in which the staff is drawn nearer or thrown further off, and the coats or threads, by that means, stretched or relaxed at pleasure.

The coat staff is about three inches diameter, and runs all the length of the beam, and on this are fixed the coats or threads for making the threads of the warp cross each other. The coat staves correspond in this kind of loom with the spring staves and treadles, in the common looms, and that of the low warp.

The coats are little strings fastened to each thread of the warp by a kind of sliding knot which forms a kind of mesh or ring. The use of them is to keep the threads of the warp separate in a proper manner, to give a passage for the brouches on which the silk, worsted, or other matter is wound for forming the woof, and expressing the design of the piece.

The broach is made of hard wood, and is seven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This serves as a shuttle; the silks, worsted, &c. designed to be the matter of the woof, being wound round it.

The reed or comb is also made of wood, and is eight or nine inches long, and one inch thick on the back, from whence it grows thinner to the extremity of the teeth, which are more or less distant from each other, according to the greater or less degree of fineness of the intended work.

The needle resembles the common sewing needles, only it is both thicker and larger. The use of it is to settle and adjust the threads of the woof, where any appear out of their proper place, or not answer well their office.

The weaver has, besides this apparatus, a number of little sticks of different lengths, but all of them of about an inch in diameter, which he keeps near him in baskets; and these serve to make the threads of the warp cross other, by passing them through in the proper manner. But in order to fix them thus across each other, a packthread is run among the threads, above each stick.

The loom being thus formed and mounted with its warp, the weaver next applies himself to draw, on the threads of the warp, the outlines and principal touches of the design to be executed in the pieces of tapestry. This is done by fixing cartoons, made from the painting intended to be copied, to the side that is to be the reverse of the tapestry, and then with a black lead pencil following the lines, and tracing out the contents of it on the thread of the right side, so that the strokes appear equally both before and behind.

The original design or painting to be copied is also to be hung up behind the workman, and wound on a long staff, from which the proper parts of it are unrolled from time to time as the work goes forward.

Every thing being thus prepared for the work, the weaver places himself on the wrong side of the warp of the piece, with his back towards the design or painting, to which he first turns, that he may see what is necessary to be done; then, taking a broach-full of the silk or worsted, &c. of the proper colour, he places it amongst the threads of the warp, which he brings cross each other with his fingers, by means of the coats or threads fixed to the staff, and being thus carried cross the loom, he returns again, when the work admits of it, or otherwise does the same with some other colour. When he has passed the threads one course, he beats them with the reed or comb till they come properly close. If any change is to be made on the work, he turns again to the painting to take a fresh clue, and as soon as a proper quantity of the work is done, he goes

round to the right side to see what effect the colours he has employed may have, and adjusts and settles the threads, which are faulty and irregular, with this needle.

As the parts of the work are finished, the piece is wound on to the lower roller, and as much of the warp unwrought is unwound from the upper; the same being done likewise correspondently with the design or painting hung behind the weaver.

When the pieces are wide, several workmen may be employed at once; but the work proceeds, nevertheless, in the manner of weaving, much slower than in that of the low warp; even in the proportion of double, both with respect to the time and labour. There is, nevertheless, no material difference in the work when done; for all the distinction which is observable by the eye is, that, as was before observed, in the low warp there is a red fillet, about the twelfth of an inch broad, which runs on each side from the top to the bottom, and is never found in the work of the high warp.

Of the manufacture of Paper Hangings.

THE paper manufactured for hangings is of several kinds, some being made in representation of stucco work, for the covering of ceilings, or the sides of halls, stair-cases, passages, &c. and others in imitation of velvet, damask, brocades, chintz, and other such silks and stuffs as are employed for hanging rooms. The principal difference in the manufacture lies, however, in the grounds; some of which are laid in varnish, and others in the common vehicles for water colours, and in the raising a kind of coloured embossment by chopt cloth.

This embossed sort is called *flock paper*; the art of making which is of very late invention, and is a great improvement of the manufacture of paper hangings, both with regard to the beauty and durability.

Of the unwrought Paper proper for Hangings.

The kind of paper employed for making the paper hangings is a sort of coarse cartoon manufactured for this purpose, and there being a particular duty on paper hangings, it is required, under considerable penalties, to be stamped before it be painted, or otherwise decorated for this purpose. There is no occasion, however, to be more particular in explaining the qualities of this kind of unwrought paper, because it is to be had of all the great dealers in paper, manufactured in a proper manner.

Of the Colours proper to be used for Paper Hangings.

The colours proper to be used for the painting or colouring the paper hangings, are all the kinds that can be used in water and varnish; but, for common designs done with water only, the following are most proper.

For *red*, lake, vermilion, rose pink, and red ochre. For *blue*, Prussian blue, verditer, and indigo. For *yellow*, the yellow berry wash, Dutch pink, and yellow ochre. For *green*, verdigrise, or a mixture of the blue colours with the yellow colours, particularly with the yellow berry wash. For *orange*, vermilion, or red lead, with Dutch pink. For *purple*, a wash made of logwood, or a mixture of the lake, or rose pink, with deep coloured Prussian blue, or with indigo. For *black*, ivory black, and, in some nicer cases, lamp black. For *white*, whiting; and for the heightenings, white lead.

Where great brightness is required, the lake should be used for the crimson red, and Prussian blue for the blue; but, for many purposes, rose pink used alone for the crimson red, and indigo mixt with whiting for the blue, will answer the purpose with greatly less expence.

The lake, rose pink, Prussian blue, and Dutch pink, intended for this use, should be had, of those who make them, in a moist state, before they have become more dry than to be of the consistence of paste. There is a double advantage in this, that they save the trouble of levigation; and, mixing much more kindly with the

vehicle than when they are dry, and to be ground afresh, they both spread much farther on the work, and, lying more even, appear to be brighter.

The yellow berry wash employed for this use may be prepared by boiling a pound of the French berries with half an ounce of alum in a gallon of water, for an hour, in a pewter vessel, and then filtering off the fluid from the dregs through a flannel or bag, or through paper for nicer uses; returning afterwards the filtered tincture into the pewter boiler, and evaporating away part of the fluid till the remainder become of the strength required, which may be tried by spreading it with a pencil or common paper. When this is used for grounds, no farther mixture is necessary. But when it is used for painting, this tincture or wash should be rendered thicker by the addition of half an ounce of gum Senegal or Arabic to a quart or more of the fluid, if found necessary. This wash thus prepared is extremely useful and cheap, and is indeed almost the only yellow used for common purposes, either for grounds or paintings.

The logwood wash may be made by boiling a pound of logwood in two gallons of water, till one half the fluid be washed away, and then straining it through a flannel bag, white of a boiling hear, adding to it afterwards about a dram or tea-spoonful of pearl ashes, and evaporating so much of the remaining fluid as may render it of a proper strength of colour.

When this purple is desired to be redder, half a pound of Brasil wood, or of Campeachy (called Peachy) wood, may be added, and the quantity of pearl ashes diminished to a one fourth of a tea-spoonful. The gum Arabic must also be added, as to the yellow berry wash, where it is necessary. This is not, however, of so much importance as the yellow wash; for the stain not being either very strong or bright, it does not produce a very great effect, as it is laid on a white ground, and is itself transparent.

Where hangings of more delicate designs and greater value are to be painted, particularly those in imitation of the India paper, carmine may be occasionally used. But it must be laid on with the pencil, and employed

sparingly, otherwise it would too much enhance the expence.

The colours used in varnish may be the same as those used with water; but such as are above directed to be had of the makers in a moist state, must for this purpose be had dry. Verdigrise, and, for nicer purposes, the crystals of verdigrise, (commonly called *distilled verdigrise*) are with advantage used in varnish, though not proper to be commixt with water. A tincture of turmeric in spirit of wine gives a very good yellow, for using along with the other colours, in varnish; but it must be used only on varnished grounds, as it will otherwise spread itself out of all bounds, and even run through the paper.

Of the vehicles for the Colours used either for Painting, or forming Grounds, for Paper Hangings.

The vehicles for the colours, as before observed, are such as are either formed of water or varnish. When water is used, it must be inspissated with size and gum Arabic, or Senegal. The proportion of the size must be adequate to the occasion, for if the different parcels of the size differ greatly in strength, no positive rule can be laid down. When the mixture is made for grounds, the water should be made as strong of the size as will admit its being commixt with the whiting, and, to save expence, the gum Arabic is sparingly used, or almost wholly omitted in this case. But for the colours designed for painting, a larger proportion must be allowed; though, in this case, that of the size must be diminished; for the mixture must not be too thick and glutinous, as it would prevent the sharpness and clearness of the outline when the colours are laid on either with the print or stencil.

In nicer cases, where pencil-work is required, the management of the colours, with respect to the vehicles, must be the same as with the miniature painting; for which ample instructions will be found in the first volume of this work.

When varnish is used, it must be formed of oil of turpentine, and the resins and gums which will dissolve in that menstruum.

For common purposes, the following composition may be employed :

“ Take of white resin half a pound, of sandarac and mastic each four ounces, of Venice turpentine two ounces : Powder them, and then add two pounds of oil of turpentine, and place the bottle in which the mixture is put in a warm place, where it must remain till the resins, &c. be perfectly dissolved. The varnish may be rendered thinner, where necessary, by increasing the proportion of the oil of turpentine.”

Of white and coloured Grounds for Paper Hangings.

The common grounds laid in water are made by mixing whiting with the size prepared as above directed, and laying it on the paper with a proper brush in the most even manner. This is all that is required, where the ground is to be left white, and the paper being then hung on a proper frame, till it be dry, is fit to be painted. When coloured grounds are wanted, the same method must be pursued, and the ground of whiting first laid, except in paler colours, such as straw colours or pinks, where a second coating may sometimes be spared, by mixing some strong colour with the whiting. But where a greater force of colour is wanted, the pigment or colouring substance used must be tempered with the proper vehicle prepared as above directed, and then spread over the white coat.

Yellow grounds are best made by the yellow berry wash, which being prepared as above directed, must be spread in the most even manner with a brush on the coat of whiting. If once going over do not produce a colour sufficiently deep, the operation must be repeated till the due effect be produced ; the paper being hung till it be dry on the frame betwixt each colouring.

Purple grounds may be in the same manner made by the logwood wash, prepared as above directed, where a strong colour or great brightness are not required.

The varnish grounds are made much in the same manner, by mixing the proper colour with the varnish, and spreading it on the paper, which is the only method usually practised. But a beautiful yellow, much brighter than any at present done, may be made by laying first a white coat of white lead and varnish, and then spreading it over with a tincture of turmeric made in spirit of wine, which may either be used simply, or prepared, as when to be used as a laquer, according to the recipe in p. 336 of the first volume of this work.

A much brighter pink ground than any at present made may likewise be obtained, by parallel means, from the using the Indian lake, improperly called safflower, which dissolves in spirit of wine, and will tinge the white coat laid in varnish in the most strong and beautiful manner.

Varnish grounds are sometimes made where the paper is to be painted with colours without flock, particularly where green is desired, as that colour cannot be produced of equal brightness by water; but they are most frequently where the figure is to be made by flocks. The reason why it is not oftener practised to make this kind of ground for the painted paper without flock, (considering it is more beautiful in many cases, and always more durable than the grounds laid in water) is the expence, which is much greater to the manufacturer than where grounds are laid on with water.

Of the manner of Painting the Paper Hangings.

There are three methods by which paper hangings are painted; the first by printing on the colours; the second by using the stencil; and the third by laying them on with a pencil, as in other kinds of painting.

When the colours are laid on by printing, the impression is made by wooden prints, which are cut in such manner that the figure to be expressed is made to project from the surface, by cutting away all the other part. This, being charged with the colours tempered with their proper vehicle, by letting the print gently down on a block on which the colour is previously spread, conveys it from thence to the ground of the paper, on

which it is made to fall more forcibly by means of its weight, and the effort of the arm of the person who uses the print. The manner of doing this, when more particularly explained, is thus :

The paper, being properly prepared by a ground of whiting, colour, or varnish, as above explained, is laid on a proper block, on which a piece of leather is strained. The colour mixt with its proper vehicle is spread on another piece of leather, or oil cloth, laid on a flat block, somewhat larger than the print ; which is done by a boy or man, who attends for that purpose, and having the colour by him in a pot, spreads it with a brush on the block betwixt every stroke and impression the printer makes. The print is previously cut in such manner, correspondently to the design of the painting, that there shall be a projection on the surface answering to every part where that colour intended to be conveyed by this print is necessary. The printer then takes the print either in his right hand, or, when too heavy to be so managed, in both, and drops it gently on the block, just charged with colour ; from whence he again immediately raises it in the most perpendicular direction, and lets it fall in the strongest, though most even manner, he can on the paper, increasing the force by all the additional velocity he can give the print. When this is done, the sheet printed is immediately taken off the block, and hung up to dry, and another being put in its place, the same operation is repeated till the whole quantity of paper be printed. It is easy to conclude, that there must be as many separate prints as there are colours to be printed, and they are to be used successively in the same manner as the first. But where there are more than one, great care must be taken, after the first, to let the print fall exactly in the same part of the paper as that which went before ; otherwise the figure of the design would be brought into irregularity and confusion. In common paper of low price it is usual, therefore, to print only the outlines, and lay on the rest of the colours by stencilling ; which both saves the expence of cutting more prints, and can be practised by common workmen, not requiring the great care and dexterity necessary to the using prints.

The manner of stencilling the colours is this: The figure, which all the parts of any particular colour make in the design to be printed, is to be cut out, in a piece of thin leather, or oil cloth. These pieces of leather, or oil cloth, are called stencils, and being laid flat on the sheets of paper to be printed, spread on a table or floor, are to be rubbed over with the colour properly tempered, by means of a large brush. The colour passing over the whole is consequently spread on those parts of the paper where the cloth or leather is cut away, and give the same effect as if laid on by a print. This is nevertheless only practicable without great care in parts where there are only detached masses, or spots of colours; for where there are small continued lines, or parts that run one into another, it is difficult to preserve the connection or continuity of the parts of the cloth, or to keep the small corners close down to the paper, and therefore, in such cases, prints are preferable. Stencilling is indeed a cheaper method of riding coarse work than printing; but without such extraordinary attention and trouble as render it equally difficult with printing, it is far less beautiful and exact in the effect; for the outline of the spots of colour want that sharpness and regularity that are given by prints, besides the frequent extralinations or deviations from the just figure, which happen by the original misplacing of the stencils, or the shifting the place of them during the operation.

Pencilling is only used in the case of nicer work, such as the better imitations of the India paper. It is performed in the same manner as other paintings in water or varnish; for which sufficient directions may be found in the first volume of this work, under those heads. It is sometimes used only to fill the outlines already formed by printing, where the price of the colour, or the exactness of the manner in which it is required to be laid on, render the stencilling or printing it less proper; at other times it is used for forming or delineating some parts of the design, where a spirit of freedom and variety, not to be had in printed outlines, are desired to be had in the work.

The manner of proceeding with these several methods is, in common work, to stencil first all parts of each colour in the design, and to give an outline to the whole at last, by printing with brown or black; but where there is any running part of the designs, such as scrolls, or the stems or stalks of creeping plants, or flowers, which are to be printed in any other colour than brown or black, a print must be used for them; though, if they require only brown or black, they may be done by the same print which makes the outlines.

In the finer paper, where several colours are laid on with the prints, the principal colour is begun with, and the rest taken successively, the print for the outline being laid on last. In cases where the pencil is to be used, the outline is nevertheless to be made before the colours are laid on by the pencil, if such outline is to be made at all; because that is the guide to the person who lays on the colour, and confines them to a correctness.

In paper printed with designs in *chiaro oscuro*, such as the imitation of stucco work, and bas-relieves, the order of printing must be to lay on the ground colour first, afterwards the shades, and lastly the lights; and the same rule of succession should be observed where the colours are pencilled.

The colours for painted grounds in common work are principally laid on, as was before mentioned, with size, and a small proportion of gum Arabic or Senegal, with which, being properly dissolved in water, the colours of a dry nature are to be ground in hand or horse-mills; but the moist colours may be commixed with the vehicle, by means of a strong brush only, being put together in proper pots, and well stirred about. The dearer colours, such as carmine, lake, or very bright Prussian blue, when used for paper of higher price, should be treated according to the directions given for them, when used among other water colours, in p. 137 of the first volume of this work.

Of the management of the Flock Paper.

The paper designed for receiving the flock is generally first prepared with a varnish ground, for as the

flock itself requires to be laid on with varnish, the other kind of ground would prevent it from taking on the paper, and render the cohesion so imperfect that the flock would peel off with the least violence. The ground must therefore either be varnish with some proper colour, or be that of the paper itself; but if, nevertheless, for cheapness, as was at first practised, the ground be desired to be laid on with water, such ground must be laid by the stencil, by which means the part where the varnish is to be laid for receiving the flock, must be kept entirely free from the matter of which the ground is formed. Instead of the oil of turpentine varnish, a composition of drying oil and resin, to which some gum sandarac may be added, might be used with advantage with respect to the expence; but the brownness of this mixture is injurious where the brightness of the colour of the flock is of any moment, and it is likewise somewhat more incommodious in the using, on account of its drying much slower.

It is frequently practised to print some Mosaic, or other small running figure in colours, on the ground before the flock be laid on; and it may be done with any pigment of the colour desired, tempered in varnish, and laid on by a print cut correspondently to that end.

The manner of laying on the flock is either by means of a print, or by a stencil; but as the stencil can execute nothing but detached parts, and consequently is unfit for all designs where running work, scrolls, or other more complicated ornaments, are introduced, it is extremely confined with respect to the nature of the designs for which it can be employed, and the print is therefore most generally preferred. The method of laying on the flock by means of a print is this: A wooden print being cut as is above described for laying on the colour, in such manner that the part of the design, which is intended for the flock, may project beyond the rest of the surface, the varnish is put on a block covered with leather, or oil cloth, in the same way as was before directed for the colours, and the print is to be used also in the same manner, to lay the varnish on all the parts where the flock is to be fixed. The sheet, thus prepared

by the varnished impression, is now to be removed to another block or table, and to be strewed over with flock, which is afterwards to be gently compressed by a board or some other flat body, to make the varnish take the better hold of it; then the sheet is to be hung on a frame till the varnish be perfectly dry, at which time the superfluous part of the flock is to be brushed off by a soft camel's hair brush, and the proper flock will be found to adhere in a very strong manner. When the stencil is used, the same method is to be pursued, the varnish for holding the flock being laid on by that instead of a print, and the flock afterwards strewed upon it, as in the other case.

The usual method of preparing the flock is by cutting woollen rags, or pieces of cloth with the hand, by means of a large bill or chopping-knife; but it is much more easily and better done by a machine, which may be worked by a horse-mill, at the same time such mill is employed for cutting diamonds, or any other similar purpose. In such case, the construction of that part of the machine, which is made for the cutting the flock, is this:

A box is made for containing the rags or cloths to be cut, which is open at the top, and of such size as may best suit the quantity of rags that the force employed can cut. A blade is also to be made the length of which is to be equal to the breadth of the box, and it should be strong, and must be charged with as great a weight as the force employed can be made to raise with a quick motion. The box, being filled with the rags or cloth to be cut, is placed under the blade, and made to move by hitches, after the stroke of the blade is given, just so far as where it is proper, the blade should again cut the cloth or rags; while, at the same time, the blade is lifted up, and let fall on the cloth, which it cuts through, till by successive strokes, and the progressive motion of the box under it, the whole quantity of cloth or rags in the box has been cut. The box must then be turned, so that one of the sides may become the front, and the operation must be repeated, by which means the cloth or rags, having been cut both ways, will be reduced to the state in which the matter is called flock, and fit to

be employed for the purpose of paper hangings. The work necessary for conveying from the principal mover in the mill, the motion for thrusting forwards the box, and raising the blade, may be easily supplied by any ingenious wheelwright, and need not therefore be particularly described here.

There is a kind of counterfeit flock paper, which, when well managed, has very much the same effect to the eye as the real, though done with less expence. The manner of making this sort is by laying a ground of varnish on the paper, and having afterwards printed the design of the flock in varnish, in the same manner as for the true; instead of the flock, some pigment, or dry colour, of the same hue with the flock required by the design, but somewhat of a darker shade, being well powdered, is strewed on the printed varnish, and produces greatly the same appearance.

Of ornamenting Paper Hangings with Spangles.

It was formerly practised to give a glittering appearance to the coloured ground of paper hangings, resembling the effect of a great number of small spangles. But though this kind of decoration has been for some time almost entirely disused, as to this manner of application of it, another use has nevertheless been made of it with good success, which is, the laying on the glittering matter in such figures as give greatly the appearance of silver embroidery, when the ground and colours of the paper are well adapted to that end.

The matter by which the appearance of spangle is made, is that kind of talc called isinglass, which, being reduced to a gross flaky powder, has a great resemblance to thin silver scales or powder. When it is used for a ground, it is laid on by strewing over the varnish which forms the ground, before it begin to dry; but it must not be laid on in this case so copiously as the flock requires to be, but sprinkled sparingly, that the colour of the ground may shew itself betwixt the small spangles. When it is laid on in a figure for the representation of embroidery, the figure must be printed in varnish, as for the flock, and the talc must be strewed upon it, and

treated in the same manner as flock; but in this case it may be used more copiously than in the other, and the whole of the ground of the figure covered. This sort of paper is not much in vogue at present, but it might be very advantageously applied to some purposes; for the most elegant and rich design I ever saw in paper, was executed in this way; the ground being yellow, with flowers of buff flock, and a small running figure of the spangles mixt with them; which gave the paper so much the appearance of a cut velvet embroidered with silver, that the deception could scarcely be distinguished at a small distance even by day-light.

Smalt may also be laid on the paper in the same manner as the flock or spangles, and will have a very strong effect, by the bright glittering colour it makes. It is too gaudy for common furniture, but might be applicable, very advantageously, to theatrical or other purposes, where great shew is frequently wanted.



INDEX.

A.	
A LUM, its use in ink	page 13
Amethyst, composition of glass for the imitation of,	216
Aqua fortis, composition of, for the soft varnish, 108 ;—for the hard varnish, 109 ;—how applied for the corroding copperplates,	115
Arabic, gum, its use in ink,	13
Architecture, how to engrave,	58
Arsenic, as a fluxing ingredient in glass,	172
B.	
Beard, how to be engraved,	56
Blue, Prussian, recipe for,	304
Body, in glass, what, 161 ;—what substances proper for, 161 ;—particular nature and preparation of the substances proper,	164
Borax, as a fluxing ingredient in glass,	171
Brandy, of what use in inks,	16
Broach, in tapestry weaving, what,	302
Burnishers, for engraving, 52 ;—for scraping mezzotinto plates,	128
C.	
Calking on the varnish for etching, 80 ;—on wood for engraving,	154
Calk of tin and lead for glazing earthen ware,	262
Cements in general, 33 ;—for alabaster, marble, and other stones, 33 ;—for broken glass, China, &c. 31 ;—for rock-work, &c.	33
China-ware, or porcelain, general nature of, 239 ;—compositions of, 242 ;—how formed into vessels, &c. 247 ;—how baked the first time, 248 ;—how glazed, 250 ;—how baked the second	

- time, 252;—how gilt, 256;—how painted, 257;—how to be made of common glass, p. 258
- Chrysolite, composition of glass for the imitation of 231
- Cryfals, how to be coloured, - - 226
- Cloth, how to be engraved, - - 57
- Clouds, how to be engraved, - - 60
- Coats in tapestry weaving, what, - 300
- Coat slaves in tapestry weaving, what, - 302
- Colorific matter in glass, what, 161;—substances proper for, 162;—particular nature of substances proper for, - 203
- Columns, how representing in engraving, - 58
- Comb in tapestry weaving, what, - 300
- Copperplates for engraving, how to be chosen, 45;—how cleansed after printing, 148;—how to be prepared
- Cornelian, composition of glass for the imitation of, - 220
- Corps perce, in engraving, what, - 61
- Counter-proofs of copperplates, what, - 151
- Counter-proving, designs on the varnished plates in etching, what, - 83
- Cradles for making the grounds for mezzotinto plates, how formed, 127;—how to be used, 128
- Cushion for engraving, - - 52
- D:
- Degradation of objects in engraving - 101
- Diamond, composition of glass for the imitation of, 216
- Distances, how to be engraven, - 102
- Dots in etching, how, and when, to be made, 100
- Doublets, - - - 229
- E.
- Eagle marine, composition of glass and paste for the imitation of, - - 213
- Emerald, how to be imitated in glass, - 215
- Engraving, general nature of, 44;—with the tool or graver, 49;—apparatus, or set of instruments for, 50;—particular manner of, 55;—general maxims of, 61;—in great, how performed, 60;—how performed on the varnished ground in etching, 86;—principles of, 94;—manner of, for particular subjects, - 103



258	Etching, what, 44;—general nature of, 63;—	
231	manner of, for subjects in small, 105;—appa-	
226	ratus, or set of instruments for	p. 64
	F.	
57	Flints, as an ingredient in glass,	165
60	Flock for paper hangings, how prepared,	314
300	Flock paper, what, 304;—how made,	312
302	Florence varnish,	72
	Foils, general nature and preparation of, 232;—	
	how coloured, 234;—for the imitation of dia-	
203	monds,	237
58	Foliating looking-glass plates, how performed,	293
300	Fore-grounds, how to be engraven,	102
	Flute, in tapestry weaving, what,	300
	Flux, in the forming glass, what, 161;—substances	
	proper for,	162
	Furnaces for preparing and working glass in large,	
220	177;—for coloured glass, 177;—for burning	
61	porcelain or China-ware the first time, 248;—	
151	the second time,	252
	G.	
83	Galls, their use in the composition of ink,	14
	—goodness of, how to be diminished,	16
128	—how best treated for making ink,	17
52	Garnet, composition of glass or paste for the imita-	
	tion of,	210
101	Glass in general, 158;—ingredients of,	160
216	—particular nature of the materials of,	164
102	—instruments and utensils employed for the	
100	composition and preparation of, 176;—com-	
229	mixture of the ingredients for the several com-	
	positions of, 193;—kind of, called flint-glass,	
213	184;—kind of, called German, 186;—kind for	
215	looking-glass plates, 188;—for windows and	
	other lights, 190;—for phials, 191;—white	
	transparent kinds of, in general, 193; commix-	
	ture of the ingredients for the several composi-	
	tions of, 193;—manner of fusing the several	
	compositions of, 197;—composition of the kind	
	of, called flint-glass, 184;—composition of the	
	kind of, called German or crystal glass, 186;—	
103	composition of the kinds of, proper for looking-	

- glass plates, 188;—composition of the kinds of,
 proper for phials, 191;—composition and treat-
 ment of the kind of, proper for bottles, called
 the green glass, 199;—coloured compositions of
 white opake and transparent, 201;—general na-
 ture and kinds of, 201;—substances proper for
 tinging, 203;—composition of the hard kind
 of, 205;—composition for the soft kind of, 207;
 —compositions of black, 217;—compositions of
 blue, 211;—compositions of green, 215;—
 compositions of red, 209;—compositions of
 purple, 215;—compositions of yellow, 313;—
 compositions of opake and semi-transparent,
 319;—manner of fusing and vitrifying the fe-
 veral compositions of, 222;—how to be con-
 verted into porcelain - - - p. 258
Glazing for earthen and stone-ware, common kind
 of, 259;—black, 273;—blue, 271;—brown,
 272;—gold coloured, 267;—green, 268;—
 iron coloured, 272;—lemon coloured, 266;—
 red, 272;—transparent with lead, 260;—violet
 blue, coloured, 226;—white, 268;—yellow,
 266; for porcelain, 250;—how laid on, 251
Glue, common, 27;—compound, strong, 28;—
 of isinglass, 27;—kind of, called lip glue, 29;—
 that will resist moisture, 28;—parchment, 28
Gravers, how made, 50;—how to be held and
 handled, 53;—general manner of managing of, 53
Grounds, in etching, what, 63;—composition and
 preparation of the hard kind of, 72;—of the
 soft kind of, 68;—how to be laid on the plate,
 75; how to be blackened, 77;—how taken off
 the plate, 121;—how to be dried, 77;—how to
 be whitened, 79;—ivory, for painting in mini-
 ature, how best prepared, 298;—for paper hang-
 ings, common, 307;—varnished, 308;—for
 mezzotintos, - - - 127
Gum Arabic, its use in the composition of ink, 14;
 —how best treated in the composition of ink, 17
 H.
Hair, how to be engraved, - - - 56

I.

- Ink, general nature of, 13;—writing, kinds of, 14;—black, nature of, 14;—composition of the common kind of, 16;—improved, 18;—without galls or green vitriol, 19;—powder for, 19;—green, 21;—yellow, 22;—red, 20;—from vermilion, 21;—perpetual of the antients for letters on stones, 24;—portable, 20;—printing, what, 13;—composition of, 22;—secret, — p. 24
- Isinglass, how used for spangling paper-hangings, 315
- Instruments, for engraving, 50;—for etching, 64;—for printing copperplates, 136;—for scraping mezzotintos, — 127

L.

- Landscips, how to be engraved, — 59
- Lapis lazuli, how to be imitated by a composition of glass, — 219
- Lead, as an ingredient in glass, — 168
- Light red, or ochre, — 293
- Logwood, how used for ink, — 15
- Looking-glass plates, composition of, 188;—general nature of the glass for, 187;—how foliated or silvered, — 293
- Loom for tapestry weaving, by the high warp, 301;—by the low warp, — 299
- Lutes, — 30

M.

- Masticot for glazing earthen and stone ware, 261
- Marbled paper, 283
- Metals, effect of, how to be produced in engraving, — 58
- Mixture for defending copperplates from more corrosion than is proper, according to Le Bosse, 111;—improved according to Cochin, 111;—how to be applied, — 112
- Moulds for papier mache, — 275
- Mountains, effect of, how to be produced in engraving, — 59

N.

- Needles for etching, how made, 64;—round-pointed, how to be formed, 87;—how to be used, 87;

- oval-pointed, how formed, 65;—how to be used, 90;—whether best to cut the plate or not, 93;—for tapestry weaving, what, - P. 303
 Nitre, as an ingredient in glass, - 170
 O.
 Oil stones for engraving, - 66
 Ochre, light or red, - 286
 P.
 Paintings, how to be taken off old cloths and transferred to new, - 286
 Paper, unwrought kind, proper for hangings, 304;—how marbled, 283;—how wrought whole in to boxes, cups, &c. 278
 Paper-hangings, kinds of, 304;—colours proper for, 305;—vehicles for, 307;—common grounds for, 308;—varnished grounds for, 309;—manner of painting, 309;—how ornamented with flock, 313;—with spangles, 315
 Papier mache, general nature of, 274;—how gilt, 282;—how moulded, 275;—how painted, 280;—preparation of, 275;—how varnished, 281
 Pastes, preparation of, - 29
 Pearl-ashes, as an ingredient in the composition of glass, - 168
 Plush, effect of, how to be produced in engraving, 58
 Points or dots, in etching, when and how to be made, - 100
 Pomegranate peel, how used in the composition of ink, - 15
 Porcelain. See China ware
 Printing with copperplates, instruments of, 136;—manner of, 139; with wooden plates, 134;—in chiaro oscuro, 152;—with a variety of colours to imitate painting, - 131
 Printing balls, how made, - 137
 Printing ink, composition of, 12;—how rendered fit to print on gilding, - 149
 Privet berries, how used in the composition of ink, - 15
 Proofs of copperplates, what, - 149
 Prussian blue, recipe for, - 304

INDEX.

323

R.

Reed, in weaving tapestry, what,	302
Retracing on the varnish, in etching,	80
Rolling-press for printing copperplates,	136
Ruby, how to be imitated by compositions of glass,	209

S.

Sand, as an ingredient in glass,	164
Sapphire, how imitated by glass,	212
Saw-dust, how to be formed into the light Japan-ware,	279
Scrapers for mezzotintos, what,	128
Scraping in mezzotinto, what, 44 ;—general nature of, 125 ;—instruments for, 127 ;—particular manner of,	130
Sculpture, effect of, how to be produced in engraving,	57
Sealing-wax, general nature of, 35 ;—hard black, 37 ;—hard blue, 37 ;—hard green, 37 ;—hard red, 36 ;—hard purple, 37 ;—hard yellow, 37 ;—soft coloured, 38 ;—soft uncoloured, 38 ;—manner of forming into sticks, balls, &c. 38 ;—methods of perfuming,	40
Silks, effect of, now to be produced in engraving,	58
Silvering looking-glass plates, how performed,	293
Size, kinds of, and how prepared,	29
Smalt, how used for decorating paper hangings,	316
Spirit of wine, of what use in inks,	16
Stuffs, what, and how made,	66
Stuchum of the ancients,	24
Sugar, how used in the compositions of inks,	15

T.

Talc, as an ingredient in glass,	167
Tapestry, how wove by the high warp, 301 ;—by the low warp,	298
Topaz, how imitated by compositions of glass,	314
Turquoise stone, how to be imitated by a composition of glass,	221

V.

Varnish for etching ;—see Ground ;—for paper hangings, 309 ;—for wooden pales,	297
Velvets, effect of, how to be produced in engraving,	58

Vinegar, how used for ink,	-	16
Vitrification, nature of, 159;—due degree of, how to be known in the preparation of glass, 195;—how to be promoted when too slow,	-	197
W.		
Water, effect of, how to be produced in engraving,		59
Washed prints, how to be produced more valuable than by the common method	-	150
Wine, how used in the composition of ink,		16
Wood-ashes, as an ingredient in glass,		150
Y.		
Yellow berry wash, how prepared for colouring paper hangings,	-	306

END OF THE SECOND VOLUME.



16

07

99

00

66

00

66